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Cast Bronze Memorial Figure

Equipment Employed In Making Mold

BY PAT DWYER

Steps from Sculptor to Customer Noted

THE ANGEL OF DEATH

Fig. 1—Bronze figure 6 feet high, 5/16-inch thickness of metal, represents the work of a molder for six weeks

FROM the earliest time bronze has been recognized as the metal for commemorative purposes. The most recent proof of its practical immunity to corrosion is presented in a bronze helmet brought to the United States from the Phillipine islands and claimed to be the identical head piece at one time owned and worn by Magellan. He was murdered by the natives in 1521. His bones long since have moldered into silent dust. Not a vestige remains of any marker set up by his companions to distinguish his grave; but the old bronze helmet fashioned cunningly by the hands of a clever Spanish smith 400 years ago is as strong, as bright and apparently in as satisfactory condition as when the dauntless old navigator clapped it on his head and sailed "Westward Ho!" on the first ship that ever circled the earth.

Nations and individuals in response to a universal and deep-rooted sentiment old as the history of the human race have erected monuments to commemorate the deeds of the living and the virtues of those who have departed. No race, no age, no clime has a monopoly in this respect. The practice probably will continue until the sun grows dim in the heavens, until the wheeling constellations are blotted out of the sky and until the earth which has supported its countless millions in life and finally gathered them to its bosom in death, shall be no more.

Many materials have been employed for the purpose and their selection has been dictated by circumstance and in some cases by necessity. Marble, granite, semi-precious and precious stones enter into the construction of many famous tombs and have retained their shape for varying periods of time. With the possible exception of the Pyramids they gradually have disintegrated from the effect of prolonged exposure to the atmosphere, rain, hail, frost and snow and the expansion and contraction incident to the changing seasons. They have passed away and been forgotten as completely as the most pitiful little wooden marker ever set up by the survivors of an exploring party over the final resting place of one of their number in the desolate, waste places of the earth.

Adaptability of the material plus the opportunity of having the work done locally and of personally noting the various steps in the process from the first clay model to the finished casting recently prompted a Cleveland man to decide on a life size bronze figure of the *Angel of Death* for a memorial over his wife's resting place in Lakeview cemetery.

The design was conceived by H. N. Matzen and the clay model and plaster pattern were prepared in the studio which he maintains near the Cleveland School of Art where he teaches fourth year students. Following a course of study which continued over a period of 11 years in Paris and Rome, Mr. Matzen became connected with Tiffany's, New York as chief designer. Later he opened a studio in Cleveland where he designed many notable figures and groups that

afterward were erected in various cities under his direct supervision. Perhaps the best known nationally is the towering shaft surrounded by groups of heroic sized figures which in the city of Indianapolis marks the appreciation of the people for the sailors and soldiers who trooped to the colors in the dark days of the Civil war.

The casting for the angel shown in the accompanying illustration was made by the Harsch Bronze & Foundry Co., Cleveland. To simplify the process in the foundry, the pattern was prepared in four sections, the body proper, the two wings and the arms joined by the clasped hands. By referring to the illustrations it may be noted that provision is made at the various junction points for a close and intimate connection. For example the projections on the ends of the arms are designed to fit in the corresponding sockets on the body. They are riveted in place and then the raised ring of metal is hammered down, filed and scraped in such a manner that the finished joint defies detection. The arms are hollow as are the wings. The method adopted for forming the cores in the arms and wings and for holding them in position afterward, is similar to that employed on the main figure. A description of one will serve for all three. One of the wings as it appeared just after leaving the mold and with the extensive runners still in position, is shown in Fig. 9. The arms casting is

FIG. 2—PLASTER PATTERN OF THE MAIN FIGURE

shown leaning against the lower gate.

Large bronze figures either single or part of a group are made according to either one of two methods. In one a thickness of wax is employed to represent the pattern. It is enclosed between the inner and outer walls of the mold during the construction period and is melted out after the mold is completed and while it is drying. Metal then is poured into the cavity left by the wax and naturally it duplicates every feature including the thickness. This is known as the *cire perdu* or lost wax process.

In the second method a plaster pattern is prepared and the mold is made in sand in an iron or steel flask. With the exception of several features connected with drawbacks and the core, the method pursued in making the mold does not differ from that practiced in the ordinary jobbing foundry in the production of castings of the same general size and shape. A two-part flask is employed. It is rolled over, the cope is lifted off, the pattern is removed, the core is set, the flask is closed and the metal is poured into the mold.

However, much preliminary work is required before the pattern is delivered to the foundry. Up to a certain point this preparatory work is the same whether the casting is to be made according to one or the other of the methods indicated. The figure shown in the accompanying illustrations was molded and cast according to the second method and the following description applies to this method alone.

Having decided on a definite design for the proposed memorial the sculptor

FIG. 3—THE ENTIRE UPPER SURFACE OF THE PATTERN WAS COVERED WITH CORES OR DRAWBACKS PROVIDED WITH SUITABLE ARBORS AND ALSO WITH GUIDES CUT IN THE SAND JOINT TO FACILITATE THE PROCESS OF ASSEMBLING THEM AFTER THEY HAD BEEN REMOVED AND DRIED

prepared a perspective sketch to illustrate what he had in mind. With the sketch for a guide he fashioned a clay model about 12 inches high in which every feature of the finished figure was worked out accurately in detail. The clay model then was set up on a suitable stand where the sculptor constantly referred to it for verification in constructing a life size duplicate, also in clay.

The Plaster Pattern

A plaster casing was built up around the clay figure to form a mold for the plaster pattern. This casing corresponded with the loam wall which the molder builds on the outside of a pattern in ordinary foundry practice. A thin coating of plaster, tinted blue for a purpose which will be explained later, was painted on the clay figure. This was followed by thicker plaster poured into suitable rough wood forms built up around the clay figure in successive tiers until it was completely enclosed. The wall was parted by thin strips of sheet iron at a few convenient points to facilitate the removal of the clay and later the application of the plaster to form the pattern for the foundryman.

The plaster mold was taken apart, the clay was removed and then after the inside surface had been thoroughly cleaned and oiled the mold was reassembled several sections at a time for the convenience of the man applying the plaster to form the pattern. The plaster was applied by throwing it against the face of the mold in handfuls in the same manner that a molder applies loam to the face of the brickwork on any loam mold. It is apparent that if the plaster mold had been assembled in its entirety at first, an extremely difficult problem would have been presented in the application of the plaster. With the mold in several sections the plaster easily was applied to one part at a time until the entire face of the mold was covered with approximately 1 inch thickness of plaster. Since only one casting was required and since the pattern itself never would be used again except possibly for exhibition purpose, no particular care was exercised afterward in the removal of the plaster mold from the outside. It may be noted in passing that up to this point the two methods referred to for making the pattern are fairly parallel. At this stage of the process they separate. For example, the plaster mold employed in the *lost wax* process, carefully is built up in jointed sections that may be removed and reassembled many times for the production of as many wax patterns as may be required as in ordinary practice.

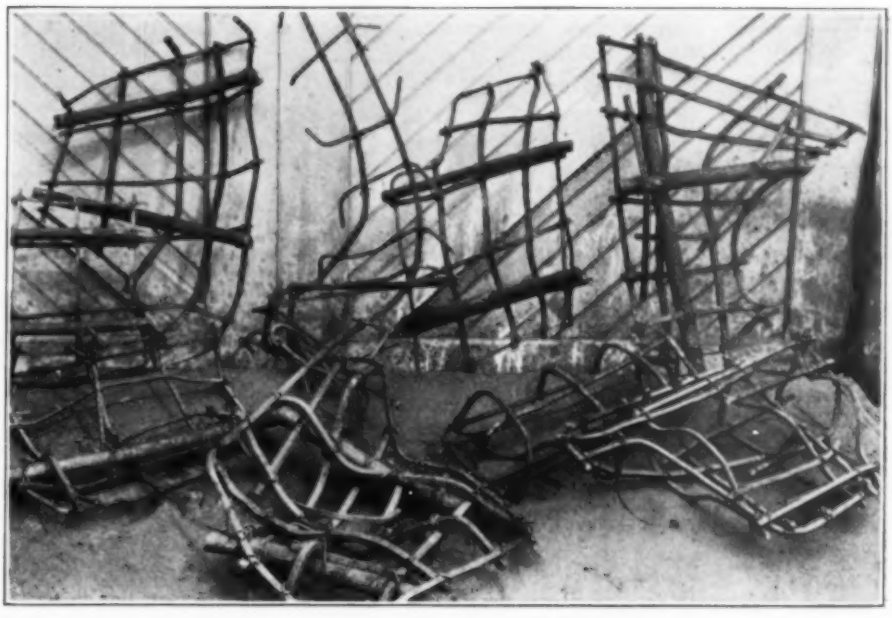


FIG. 4—CORE ARBORS ARE FORMED FROM PIECES OF STEEL BAR BENT TO THE DESIRED SHAPE AND WIRED TOGETHER AT THE POINTS OF INTERSECTION

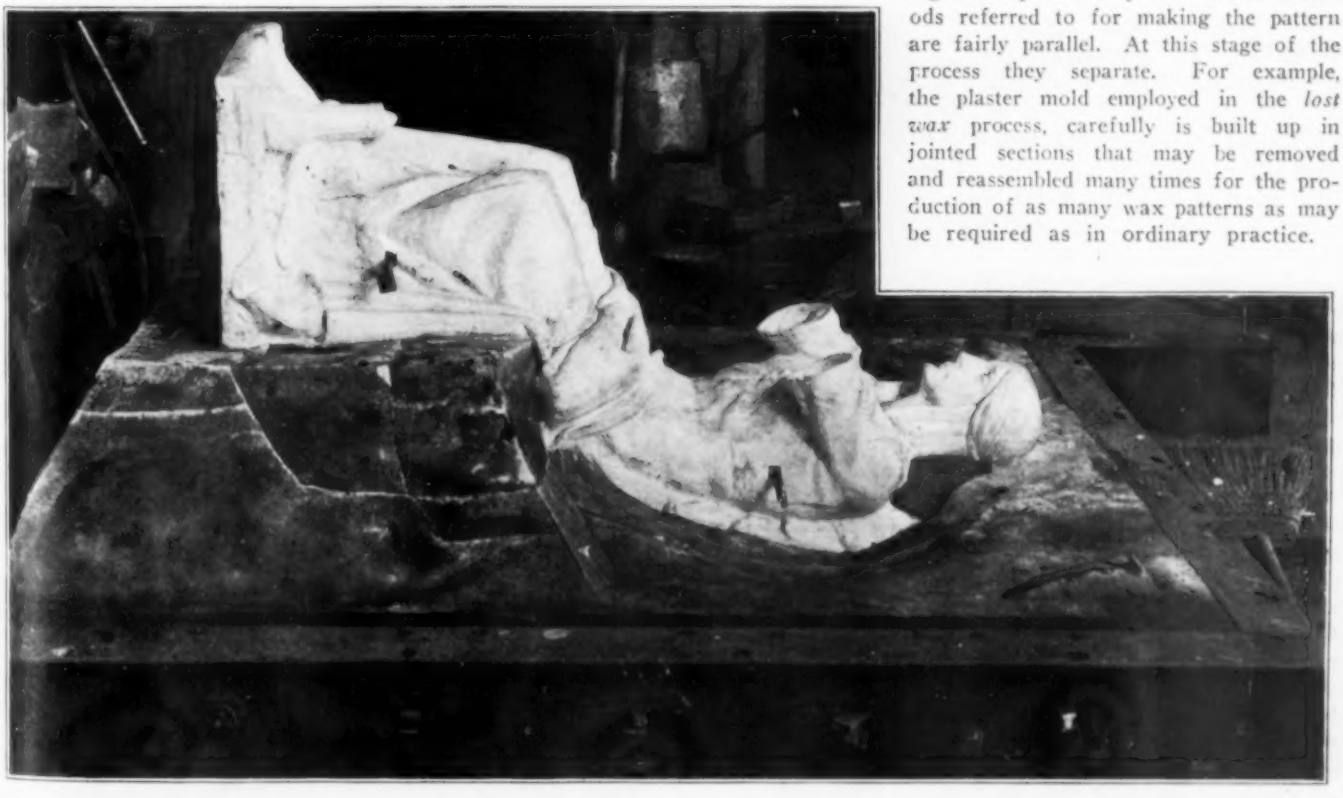


FIG. 5—THE DRAG AND PATTERN AS THEY APPEARED AFTER THE COPE AND THE VARIOUS DRAWBACKS HAD BEEN REMOVED—THE CHAIN HOOKS WERE ATTACHED TO THE TWO BOLTS SHOWN IN THE SIDE OF THE PATTERN TO LIFT THE PATTERN OUT OF THE MOLD

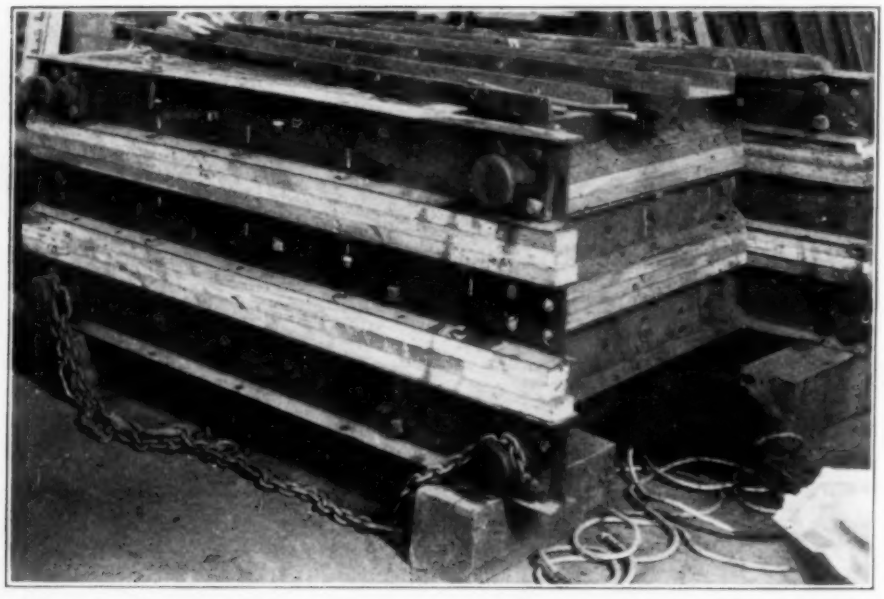


FIG. 6—SIDES AND ENDS OF THE COPE FLASK ARE FORMED FROM SECTIONS OF STEEL I-BEAM AND MAY BE ASSEMBLED IN VARIOUS COMBINATIONS TO SUIT ANY STYLE OF CASTING

The rough outside plaster mold was chipped away with a hammer and chisel and when the chipper noted the blue tint on the plaster he realized that he had arrived close to the face of the desired plaster pattern and proceeded cautiously to remove the remainder. All minor ridges and other surface imperfections were removed and after the sculptor had satisfied himself that the pattern conformed to his conception of what it should be, it was taken to the foundry of the Harsch Bronze & Foundry Co., where the mold was made in the manner shown in several of the accompanying illustrations.

Use a Knockdown Flask

On account of the wide variety in design which characterizes the patterns presented in this line of the foundry business, also on account of the fact that the same casting seldom or never is duplicated, it has been found advisable to provide a knockdown flask that may be assembled in many combinations. This feature may be appreciated more readily by referring to Fig. 6 showing the manner in which the cope was built up for the casting under consideration. The sides and ends were formed from lengths of 8 inch steel I-beams bolted together at the four corners. The lower edge of the I-beam served as a sand strip all around the interior of the flask. Chuck bars bolted to the sides and long rods extending from side to side and with the ends wedged tightly in square holes in the I-beams, served to reinforce the sand and hold it in position. Three steel channel beams bolted flat on top of the cope prevented the sand from rising under the pressure of the molten metal when the mold was filled.

In making the mold, the empty cope was placed on the floor with the joint side up. It was partly filled with sand from the heap and then the plaster pattern was adjusted approximately in the center and tucked into place with the natural parting line conforming as nearly as possible with the joint line of the flask. This arrangement was only temporary. The cope in this instance serving merely as a followboard to hold the pattern in place while the drag was being rammed full of sand.

The exposed part of the pattern was covered with French sand, then the remainder of the drag was filled with heap sand and after it was rammed, three pieces of channel beams were bolted over the bottom to serve as a bottom plate. A short piece of steel rail bolted across the center of the drag outside the channels prevented the channels from springing in the center. This feature may be observed in Figs. 5 and 8. The two halves of the flask were bolted together and then the entire assemblage was rolled over and after the cope was removed the drag and pattern appeared as in Fig. 5. The sand was shaken out of the cope and the empty cope was placed to one side until after the many drawbacks had been rammed over the face of the pattern. The general appearance of the drawbacks may be noted in Figs. 3 and 10. Those in Fig. 3 are green sand just as they were removed from the pattern and those in Fig. 10 are dried. In all 37 of these drawbacks or *undercuts* as they usually are designated, were employed in forming the mold.

French Sand Necessary

French sand which so far as known has no counterpart in this or any other country, was employed exclusively in those parts of the mold which came into actual contact with the pattern. This sand has peculiar properties which render it particularly adaptable for statuary molding. It is extremely porous and may be rammed hard without affecting its permeability. After it is rammed it dries in the atmosphere to such an extent that a block of it may be handled

FIG. 7—METAL WAS MELTED IN A BATTERY OF FIVE OIL FIRED CRUCIBLE PIT FURNACES AND POURED INTO A HEATED 1-TON LADLE WHICH CONVEYED IT TO THE MOLD

almost as readily as a core that has been dried in the oven.

Typical arbors employed for reinforcing cores and drawbacks on castings of this character are shown in Fig. 4. They are made from pieces of ½ or ¾-inch square bar bent to the required shape and with the various parts wired firmly together at the various points of intersection. Short pieces of pipe are incorporated in the arbors where it is desired to turn the cores over while they are green. The position of the pipes is indicated in Fig. 4 and the manner in which they are utilized is illustrated in Fig. 3. A long bar or piece of pipe is shoved through the pipe attached to the arbor and serves as a handle in lifting, turning and afterward supporting the core or drawback on suitable supports. The handles, of course, are removed after the core has been returned to place.

To avoid any possible misunderstanding it may be well at this point to state that the entire upper surface of the pattern was covered with the blocks of sand shown in Fig. 3. After they had all been arranged in their proper position the cope flask was set on and rammed full of sand. Then the cope was removed and set down on blocks as shown in Fig. 6. From this description it is apparent that the cope simply served as a frame or container to hold the various individual blocks of sand in place. Suitable gate sticks were arranged in the cope to provide a channel from the runner basin to the various openings through the drawbacks and into the cavity forming the mold.

The molder arbitrarily decided where the parting lines should be drawn on the pattern. He was actuated by the desire to cover the pattern with the least number of individual pieces that conveniently could be removed and afterward returned to place. In the foreground of Fig. 3, it may be noted that the largest core covered the figure from the head to the waist line. On account of the many undercut surfaces on the remainder of the figure a great many small cores were required before the entire surface was covered.

The manner in which the various blocks were parted and built up around the pattern may be noted in Fig. 10 where they are shown in process of being returned to place after removal from the oven. Each block was provided with suitable hooks by which it was lifted away before the removal of the pattern and returned to place at a later stage of the proceeding. Also a suitable dovetail guide was cut on several faces of each block to insure an accurate fit between the various blocks on their final assembly. This feature is shown distinctly at *A*, Fig. 10, and also may be noted on nearly every core shown in Fig. 3. Suitable gate pins were inserted here and there through the various cores to provide a simultaneous distribution of the metal to all sections of the casting.

As stated previously the cope was rammed after the various cores had been constructed over the entire upper surface of the pattern. The outside surface of the assembled cores presented a fairly uniform appearance, slanted on the sides and ends to facilitate the removal of the cope. The cope was lifted and placed on blocks as shown in Fig. 6 and the drawbacks were removed one at a time and placed on horses as shown in Fig. 3. The pattern and drag then appeared as in Fig. 5. The crane chains were attached to the bolts driven through the pattern and projecting at each side. After the pattern was removed from the mold it was placed on the wood pedestal originally prepared to support it in the journey to and from the foundry. This is shown in Fig. 2.

The method adopted for making the main core in one of these castings differs materially from that employed in ordinary foundry practice where a sweep or a corebox is supplied for the purpose. In this instance the mold was utlized for a corebox, and was rammed full of sand. Afterward the mold was taken apart, a thickness of sand corresponding to the desired metal thickness of the casting was shaved from the core. Then the mold was closed and poured. Briefly, the foregoing describes the process, but from the intricate character of the work it is apparent that the progress was slow and that the highest degree of skill and accuracy were required on the part of the operator to insure success.

A frame constructed after the same general plan shown in Fig. 4 and conforming approximately to the general contour of the mold was prepared and fitted in place in the drag part of the mold. Projecting members of the arbor, two of which are shown at *BB*, Fig. 8, were designed to rest on the joint of the mold and anchor the core definitely in place. With the arbor in place the drag half of the mold was rammed

FIG. 8—THE BODY CORE NEVER WAS LIFTED OUT OF THE MOLD—THE THICKNESS WAS SHAVED FIRST FROM ONE SIDE AND THEN FROM THE OTHER SIDE—AFTER THE MOLD WAS DRIED AN AIR HOSE WAS EMPLOYED TO REMOVE ANY DUST FROM UNDER THE CORE

full of French sand. Then the first tier of drawbacks was assembled in place and the core was rammed higher. The process was continued until the entire interior of the mold was rammed full of sand. The cope then was set on and after the two halves of the mold had been clamped together, the entire mold was rolled over and the drag was removed, thus exposing one side of the main core.

Short nails with broad heads were inserted within a few inches of each other all over the exposed surface of the core. The heads were driven flush with the surface of the sand and furnished a fairly reliable guide for the removal of the required thickness of sand. The sand between the nails and to the required depth under the heads was removed by hand with small sharp tools. To avoid confusion it is advisable at this point to explain that the main core never was removed from the mold. It was left in place and the thickness of sand was removed first from drag side and afterward from the cope side.

Sheet Wax for Support

Having served their purpose the nails were removed and the surface of the core was painted with molasses-water-blacking. The casting was designed for 5/16 inch thickness of metal. This amount of sand was removed from the core. To prevent any sagging during the drying process and also to prevent

FIG. 9—ILLUSTRATING THE MANNER IN WHICH THE RUNNER ALMOST COMPLETELY SURROUNDED THE CASTING—THE TWO ARMS MERELY WERE LEANED AGAINST THE GATE FOR PHOTOGRAPHIC PURPOSE

sand from falling into the cavity, wax sheets to a thickness of 5/16 inch were spread over the core and then the drag was replaced. The entire mold once more was clamped together and rolled over which brought it back to normal position, or in other words, to the position in which later it was poured.

The cope was removed for the last time and lowered onto the blocks on the floor. The drawbacks then were removed one at a time, commencing at the top, and placed on the horses where they were retouched and painted with blacking mixed with molasses water. Afterward they were placed in the oven to be dried. The same procedure previously described was adopted in removing the thickness of sand from the side of the core now exposed. Nails were inserted with the heads flush with the surface and the sand between them was cut away to a depth of 5/16 inch. Gates were cut along the joint to connect with the gates in the drawbacks. The surface of the core and the joint of the mold were painted with blacking and then the drag with the core in position, was placed on the oven car and dried in the oven. A high plate bolted temporarily to the end of the flask served to brace the comparatively thin body of sand extending above the surface of the drag at one end. This thin block of sand formed the interior of the pedestal supporting the lower part of the statue.

Assemble Drawbacks

After the mold was dried it was taken from the oven and assembled as shown in Figs. 8 and 10. In Fig. 8 the molder is shown with an air hose blowing any dust that may have collected in the drag half of the mold under the core. During the drying process the wax melted and evaporated through the sand. In Fig. 10 the mold is shown with several drawbacks assembled in their proper relative positions.

All the gates on the mold were di-

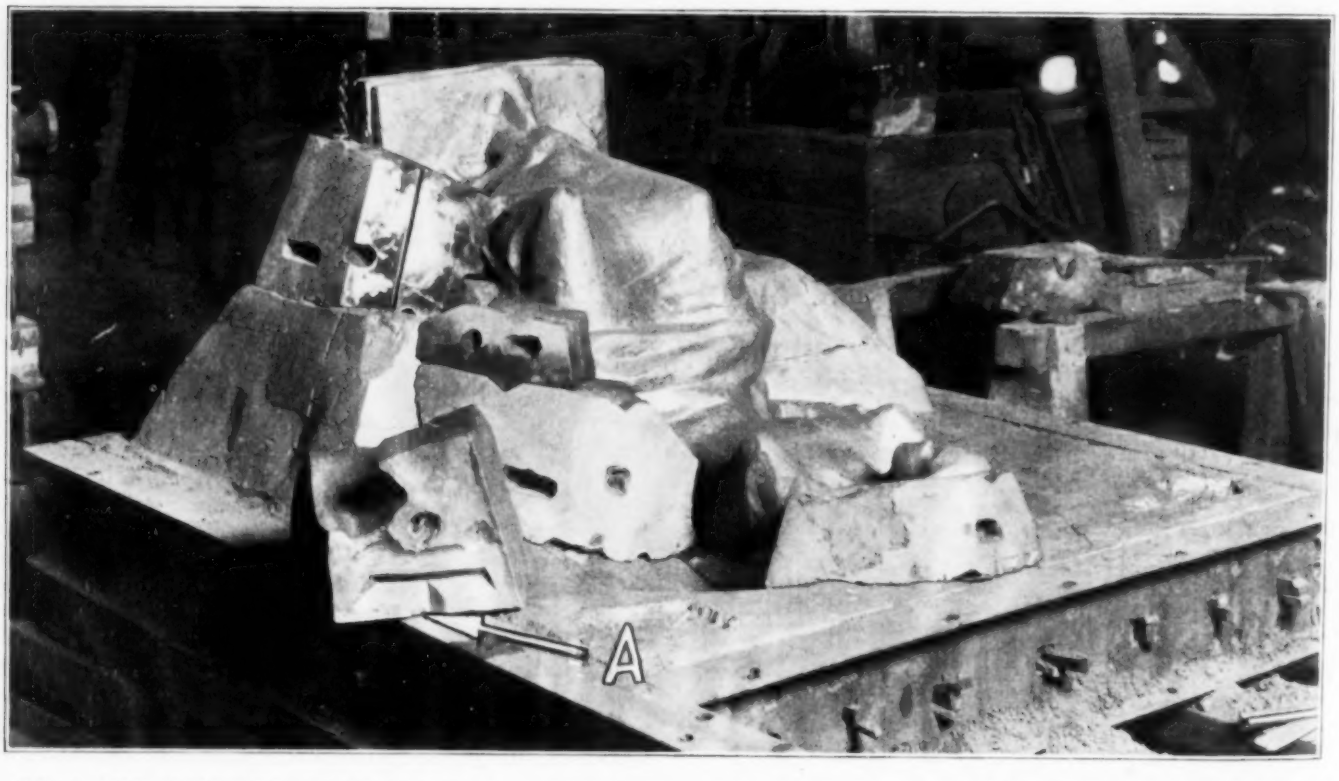


FIG. 10—THE BEGINNING OF THE PROCESS OF REASSEMBLING THE VARIOUS DRAWBACKS THAT FORM THE UPPER FACE OF THE MOLD IS SHOWN IN THIS ILLUSTRATION—AFTER THE ENTIRE SET WAS IN POSITION THE GREEN SAND COPE SHOWN IN FIG 6 WAS LOWERED INTO PLACE AND SERVED TO BIND THE ENTIRE ASSEMBLY TOGETHER

rected toward two uprights through the cope close to one end. A large basin capable of holding approximately 400 pounds of metal was prepared in an iron box and dried in the oven. It was placed on the cope with the openings in the bottom of the basin coinciding with the openings in the cope. A clay plug built around an iron rod was placed in each opening. The rod extended above the top of the basin and terminated in an eye by which it was lifted after the basin was filled with metal. In this manner an even and rapid distribution of the metal was assured to all parts of the mold. Approximately 1500 pounds of bronze were required to pour the casting and the basin easily was kept filled after the plugs were withdrawn. One small riser on the highest point of the mold served to indicate when the mold was filled.

Metal familiarly known as 85 three-fives, that is copper 85 per cent, tin 5 per cent, zinc 5 per cent and lead 5 per cent was melted to pour the casting. It was melted in five crucibles in a battery of oil fired pit furnaces and the entire charge was collected in a 1-ton crane ladle previously heated by an oil torch.

Says Future of Gray Iron Foundries Menaced

Prosperity of gray iron jobbing foundries is threatened seriously by disorganized conditions in the industry, according to A. O. Backert, president of the Penton Publishing Co., Cleveland, and former president of the American Foundrymen's association, who spoke before the Newark Foundrymen's association, Newark, N. J., June 11. Only by concerted efforts in establishing a standard for their product and in adopting uniform costs will foundrymen be in position to check the rapid enroachment of other classes of castings, forgings, etc. into their field, he declared. Mr. Backert concluded with a brief business summary in which he pointed to definite indications of a revival of activity in the relatively near future.

Referring to the failure of gray iron jobbers to see the handwriting on the wall, the speaker indicated the development which has taken place in other classes of foundry, work, notably in malleable castings. He stressed the importance of advances in the foundry industry as a whole as shown in recent years in providing improved production methods, and pointed to still further developments, which, he believed would prove little short of revolutionary. He referred particularly to castings now produced in permanent molds. The casting of pipe centrifugally, which at present is done in permanent molds, was regarded by the speaker as one of the leading developments thus far. He pointed to the significant experimental work now being done with the view to adopting permanent molds to miscellaneous castings, especially in the automotive field.

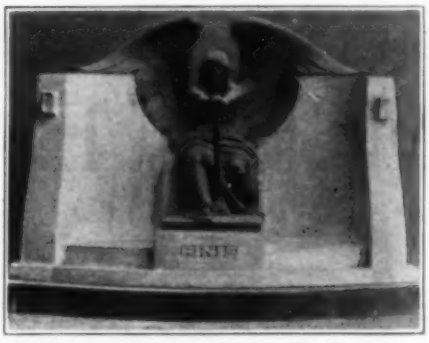


FIG. 14—ORIGINAL CLAY MODEL 15 INCHES HIGH

Discussing organization activities, Mr. Backert condemned roundly any effort on the part of a group of manufacturers to fix prices. Not only is it in direct defiance to the Sherman antitrust law, he stated, but it is economically unsound, and the organization which fails to recognize this cannot endure. Speaking specifically of the gray iron jobbing industry, he reiterated his conviction that a concerted effort should be made at once in establishing a standard for its product. Next in importance he mentioned the advisibility of establishing a uniform cost system, substantial progress toward which already has been made in some districts. Co-operation of this character soon leads to an exchange of general information of considerable importance.

Concerning business conditions, Mr. Backert observed that never before in the history of the iron and steel industry has steel production undergone as sharp a decline in a similar period as it has in the two months just ended. Production, which early in April was at a rate of 52,000,000 tons annually, dropped off until at present a rate of approximately 30,000,000 tons prevails. The decline in pig iron production also has been unusually heavy. The speaker traced developments over the past 12 months, pointing to the heavy buying noted around the first of the year for the initial quarter, and which dwindled sharply later. He spoke particularly of the activities of railroads, building and automobile industries, which take approximately 54 per cent of the country's annual production. The railroads, he said, bought substantially of cars and locomotives during the first quarter, but as shipments declined the railroads withdrew, and at the moment have a surplus of more than 300,000 cars on hand. Mr. Backert said that early resumption of buying of rolling stock is not likely.

The speaker pointed to several favorable factors, notably the easy money situation, and added that dullness never is prolonged when such conditions prevail. However, he said, that one of the most threatening factors in the country's prosperity over a comparatively long swing is its fast accumulating supply of gold. Unless the accumulation is checked, it will lead eventually to gold inflation that will so advance prices in this country that even the highest feasible tariff will not be able to keep out the flood of cheaper foreign commodities.

All officers of the association were reelected for the ensuing year as follows: President, J. L. Carter, Barlow Foundry Inc., Newark, N. J.; vice president, William Goldsmith, C. A Goldsmith Co, Newark; treasurer, J. A. Williamson, Isabell-Porter Co., Newark; secretary, W. H. Mantz, Atlas Foundry Co., Irvington, N. J.

Book Review

Inventor's Manual by George M. Hopkins; third edition revised and enlarged by A. A. Hopkins; 128 pages; 7¾ x 4¼; published by the Norman W. Henly Publishing Co., New York and supplied by THE FOUNDRY, Cleveland, price $1.50 net.

The object of this book is to give the inventor and patentee a number of valuable hints on patents generally together with approved methods of bringing them to public notice. The author was not only a scientist but a patent attorney as well.

Various phases of the subject include the faculty of inventing; the development of the invention; the exhibit of the invention and profits from the same; foreign patents and the value of patents; the inventor and the promoter, and partly expired patents.

The latter part of the book gives the latest census of occupation, population of cities of 100,000 and over, latest census by states, mechanical and design patents, with index.

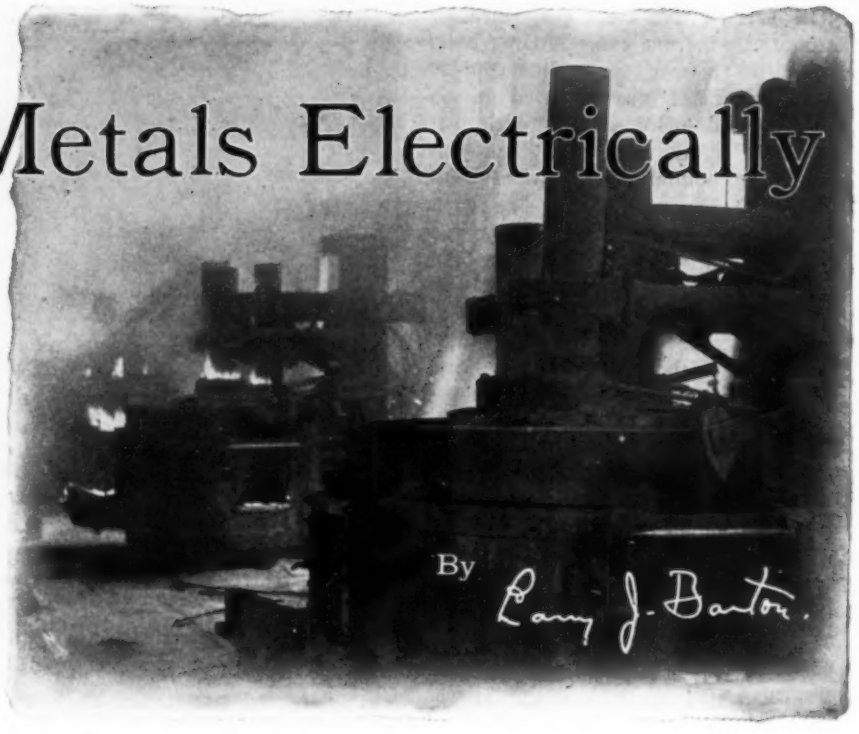
Builds New Foundry

The Fairfax Iron & Steel Co., Kansas City, Kans., is installing a complete steel foundry for electric steel castings with a capacity of 24 tons per day; one cupola for the manufacture of gray iron castings with a capacity of 20 tons of special light gray iron castings per day; two malleable iron furnaces having a melting capacity of 50 tons per day; and a frog and switch works shop 80 x 180 feet. Buildings and practically all of the machinery have been purchased.

Refining Metals Electrically

Chapter I (Continued)

Basic and Acid Linings Compared—Attributes of Known Makes



PERHAPS the greatest point in favor of the basic process is its ability thoroughly to de-oxidize and de-sulphurize. Therefore, its use is mandatory for any class of product depending upon the absence of these elements for its quality. However the acid process is noted for its speed and cheapness of conversion and naturally is favored for use wherever possible. The various conditions or products which may be served better by a basic furnace are summarized under the following classifications:

* * * *

For Manganese Steel

MANGANESE steel due to its high percentage of manganese and the affinity of this metal for silica to form a manganese-silica oxide slag rapidly slags out an acid hearth. However, manganese is negative to both dolomite and magnesite, the usual constituents of a basic hearth. Naturally, if manganese steel is to be made regularly in a furnace the basic lining is essential. If manganese steel is to be made only at rare intervals, it can be produced on an acid hearth by adding the alloy to the ladle in a molten condition.

One of the great problems of the manganese steel shop is the recovery of heads, gates, spill, etc. This is simple when using a basic furnace, as this scrap may be remelted with a small loss of manganese. Previous to the advent of the basic electric furnace, it was the custom to remelt this scrap in an air furnace with attendant high loss.

For Highly Refined Gray Iron

For such products as piston rings, pressure cylinders, valves, etc., an iron is required which is soft and of a tight, dense structure. The basic furnace, due to its powerful desulphurizing features is growing in favor for such purposes. Sulphurs have been made as low as 0.009 per cent, and strength far higher than ever obtained from the cupola metal have characterized electric iron. For large tonnages duplexing with the cupola is possible, while the basic furnace offers an unexcelled method for using cast iron borings and turnings.

Under this heading may also be classed a great variety of alloy irons used for such special purposes as the following: For heat, flame, gas, fume, and acid resisting castings; iron for special electrical purposes; special white irons for abrasive purposes, etc. The alloys in common use are chromium, nickel-vanadium, silicon, and manganese. As these are higher in price, the economy in using them is a prime necessity especially scrap recovery values.

For Remelting Alloy Steels

Due to its de-oxidizing features, the basic process is of great value in recovering such costly alloys as chromium, manganese, vanadium (partially), molybdenum, nickel, and other alloys coming into wider use such as uranium, zirconium, and boron. These alloy steels may be remelted with only the slightest losses under careful operation, and when the increased use of such metals is considered it is readily seen that this is an extremely important qualification.

For High Quality Metal

This feature covers such classes of steel as may require extensive heat treating and machining operations in which the cost of molten metal is the smallest factor, and where quality and regular composition are items of the greatest importance. In this category may fall cams, gears, steels to be operated under pressures or at high speeds, or steel to be used in cases where a failure would cost more than the initial price of several castings.

The basic process, due to the fact that the steel may be held in the furnace indefinitely offers perfect conditions for regularity of composition. The steel may be ready to tap and a test sent to the chemist and the heat held for its final adjustment, dependent upon his analysis, without the least ill effect. This feature is not found in any other method of steelmaking. Further, the metal may

What Kind of Steel?

DETERMINING whether to operate an acid or a basic electric furnace assumes major importance. More than the mere character of the lining is at stake; for of the many different classes of castings made from electric furnace metal, some are produced with better economy in the one than in the other type. For this reason a study should be made before a furnace is chosen, and from the conditions to be met should come a decision as to the character of the steel to be made. In the accompanying article the various attributes, merits and shortcomings of acid and basic steel are analyzed. The author sketches his personal judgment as to the different kinds of furnaces with which he is familiar and their parts in acid or basic service.

In the chapter which will follow, running through a number of issues, furnace installation, maintenance and operation will be treated from a practical standpoint.

be held under a carbide slag until the last trace of gas is dissipated, and may be poured with the knowledge that it is *right*. Where heat treating is of importance such conditions of real quality and regularity are of vital necessity if rejections are to be kept to an absolute minimum.

Where Economic Condidtions Favor

It may be that a shop will have the oppportunity to obtain enough special work to warrant slightly higher operating costs to obtain a greater tonnage and more regular furnace operation. For instance, this might happen in certain localities where it would be possible to make steel castings, gray iron castings, and manganese steel. While the conversion costs would be higher, the better operating figures from steady operations, and the decreased overhead, together with the higher profit from specialties might amount to enough to overcome this added cost of conversion in favor of the basic furnace.

A second case would be where it was impossible to obtain acid scrap except at a high premium for low sulphur and phosphorus. In such a case it would be a question as to whether cheap basic scrap and high conversion figures would be cheaper than high priced acid metal and low conversion costs. This can be better shown by a table of costs made up by a company which faced this condition. As soon as it was found that it was necessary for this company to have low phosphorus, low sulphur scrap, the metal dealers immediately raised their prices on this class of steel to $22 per ton, while selling ordinary basic, open-hearth scrap at $12. The solution to this problem was the decision to operate by the basic process until satisfactory scrap could be obtained at a fair figure, and large amounts of basic scrap were contracted. After several months' operation the scrap dealers came to time and basic operations were discontinued. The comparative costs follow:

CONVERSION COSTS

	Basic	Acid
Labor	$ 1.67	$ 1.33
Power	9.00	6.00
Repairs	4.20	2.10
Slag and miscellaneous	1.00	.25
Alloys	1.60	2.35
	$17.47	$12.03
Scrap @ 3% loss	12.36	22.66
Cost of molten metal	$29.83	$34.69

In this particular instance the balance was in favor of the high conversion cost and cheap scrap to the amount of $4.86 per ton of molten metal or approximately $7.48 per ton of cleaned finished castings.

A third case would be under circumstances where it was necessary to make exceedingly low phosphorus and sulphur metal, but as this is rare it does not warrant special mention.

* * * *

The foregoing summarize the more important considerations which dictate basic rather than acid operation. Next we may study the various points which favor the acid lined furnace. These are set forth under their various headings as follows:

For Ordinary Carbon Steel

FOR plain steel castings the acid process is much superior to basic operation. Furnaces designed for acid operations use higher voltages than those intended for the lengthy refining operations of the basic furnace. Consequently, the time per heat is lowered and a greater tonnage can be obtained over a given period. Shorter time of melting means a shorter period where radiation loss is effective which cuts the power consumption. This quicker operation means less electrode consumption, and lowers refractory costs. There is no large volume of limey slag to heat, and splash on the furnace walls. This means a further saving in power, and increased refractory life. Old molding sand is used for slag making which is far cheaper than a mixture of lime, fluorspar, and ground coke. Common silica sand is used for bottom making and for patching purposes being considerably cheaper than either dolomite or magnesite.

Due to the absence of this heavy slag body, and to the better heat resistance of the acid hearth, it is possible to make acid steel much hotter than basic. This is a great advantage where small size castings constitute a large portion of the shop's output. An acid slag will not attack the ladles in the same manner as will a basic slag, nor will it slag off the bricks on the stopper rod as sometimes happens on a hot basic heat. These points make for cheaper ladle upkeep, an important item in a year's time.

An acid furnace is much easier to operate than a basic unit and can be handled with less labor. Considerably less brick work is required on roof building, and repairs to the side walls and hearth are negligible. An acid bottom is kept in repair easier than a basic one due to the fact that sand used for patching tends to sinter in better than the higher melting point basic material. Furthermore, an acid hearth will not come up in lumps like one made of magnesite, and does not require any tedious slagging off except in unusual circumstances.

The main argument against acid operation is that the quality of the steel made is not as high as that made by the basic process. While it is perfectly true that a higher grade of steel can be consistently made by the basic process. The writer does not consider that such added quality is necessary for the majority of steel castings. Not only will acid furnace metal satisfy all existing specifications for steel castings, but in the majority of cases, where a first class man is in charge of melting operations, it will give tests of from 5 to 15 per cent above the required figures.

While acid steel is probably not exposed to as vigorous a reduction as basic metal, it tends to give a higher degree of solidity in the mold, especially on

Acid Versus Basic Operation

THREE TO FOUR TON FURNACE

Conditions of Operation

		Power kilowatt hour/ton	Time hours
1 heat a day	A	600-650	1:30-1:45
	B	875-900	3:00-3:30
2 heats per day	A	550-600	1:15-1:30
(2d. heat)	B	775-825	2:30-3:00
3 heats per day	A	475-525	1:10-1:30
(3d. heat)	B	625-700	2:15-2:25
24 hour operation	A	450-500	1:10-1:20
(Average)	B	575-625	2:15-2:25

Item	Acid	Basic
Number of heats poured	12	7
Tonnage-molten metal	36 plus	21 plus

Cost Comparisons

	Dollars per ton	Dollars per ton
Labor: 3 melters @ 75c hr. 3 helpers @ 50c 6 laborers @ 30c	1.23	2.11
Power: Acid 500 KwH @ 2.00c Basic 600	10.00	12.00
Electrodes: Acid 14 pounds @ 6c Basic 22 pounds	0.84	1.32
Refractories and patching materials	1.00	2.50
Slag making supplies	0.10	1.00
Alloys	0.90	0.90
Conversion cost	$14.07	$19.83
Scrap metal: $18.00 per ton @ 5% melting loss	18.90	18.90
Cost molten metal	$32.97	$38.73

green sand work, which results in a lower percentage of defective castings.

However, in one physical factor basic steel is superior to that made by the acid process, and that is in the comparative freedom from hot checks, cracks, and tears of castings made from basic steel. Acid steel if poured too hot in certain types of casting is likely to tear and greater care is necessary in the use of heads, brackets, *dogs*, and fillets. After a molder foreman once understands this pecularity of his metal, little trouble will be encountered.

Due to the nature of acid slag, tending to harden on exposure to the air, little trouble is experienced with slag inclusions where, a top pour ladle is used, this being common practice in shops which operate furnaces of the smaller sizes. The use of a bottom pour ladle which is the only real satisfactory vessel for pouring steel will prevent such troubles.

For Ordinary Gray or White Irons

Unless extremely low sulphurs are required in the iron the acid furnace will prove satisfactory. A good grade of scrap will be necessary for machine castings, and often by the judicious use of pig exceptionally high grade irons can be produced. The big feature of the electric furnace for melting iron is its ability to superheat, and this can be effected as well under acid as basic conditions. For certain classes of metal varying percentages of steel may be used, resulting in an iron of lower phosphorus and sulphur content with its attendant higher strength. Castings which formerly were poured of high phosphorus stove plate iron can be readily poured from ordinary analysis metal with no danger of a misrun. Under certain conditions synthetic iron may be made from a steel base with a phosphorus as low as 0.02 per cent which exhibits unusual qualities of strength and toughness.

For Infrequent Special Alloy Melts

Such alloy steels as nickel, chrome, vanadium, silicon, and manganese up to about 1.50 per cent may be made on the acid hearth. Manganese steel can be made by adding the alloy to the ladle in the molten condition. The great disadvantage is the fact that these alloys cannot be recovered on the re-melt which makes this method uneconomical.

* * * *

Compares Operating Costs

TO DETERMINE the actual difference in conversion costs between the acid and basic processes, experiments were carried on by the writer. The furnace was a well known make rated at 3 tons' capacity, operated under both processes by the same men, and under exactly the same conditions as to number of heats per week, etc. The scrap used was medium size and possessing approximately the same amount of phosphorus and sulphur so that there was no great attempt to reduce either of these elements when operating basic.

The steel made in both cases was to be used for steel castings only, and was made to satisfy the standard specifications of the American Society for Testing Materials for soft to medium grades. The metal made analyzed as follows: Carbon 0.22 to 0.26 per cent; manganese 0.60 to 0.80 per cent; silicon 0.25 to 0.30 per cent; sulphur and phosphorus below 0.05 per cent.

The slags on basic operation were made of a good grade of burned lime, gravel fluorspar and crushed coke. Acid slag was made of old molding sand. Slags in both cases were of such an amount as would be used under the best of operating practices, and all heats were made under the highest of metallurgical care.

The same number of heats was taken for comparison, being taken at a period when two heats were being made daily averaging 4 tons per heat. The metal was being poured into small and medium size work, each heat pouring close to 35 flasks. The operating conditions are tabulated as follows:

	Acid hours	Basic hours
Time of first heat..	1:30 to 1:45	3:00 to 3.30
Time of second heat..	1:15 to 1:30	2:30 to 3:00
Kw. Hr. per ton 1st. heat	625	885
Kw. Hr. per ton 2d. heat	550	770

From these results were calculated data on what could be expected under both methods of melting. These are shown in the accompanying Table IX.

This gives a balance in favor of acid operating of $5.76 per ton or approximately $8.87 per ton of finished casting based on a return of 65 per cent of the molten metal.

In addition to the differences in metal costs other indirect advantages are possessed by acid steel. Hotter metal is obtained and fewer castings are lost from misruns. The percentage of castings lost from slag pockets is also less, due to the greater tendency of acid slag to clean itself from the metal. Basic metal refined under a heavy carbide slag, often gives difficulty in green sand molds, causing *blowy* work. While this never has been explained satisfactorily it seems that some disolved carbide becomes liberated upon reaction with the acid mold material causing an evolution of gas often sufficient in volume to ruin the casting.

Choosing a Furnace

At present approximately fifteen or twenty makes of electric arc furnaces are available on the American market. Of these few are of such a design as to warrant successful operations from a commercial standpoint. In number installed the Heroult furnace, one of the oldest on the market, still leads.

The Heroult furnace, while being used in some cases on acid operations, is strictly a basic furnace. The power usually is arranged to give from 110 to 130 volts on the high side, and from 70 to 90 on low. This is to supply a short arc during refining with its attendant low radiation making this finishing period less severe on the roof and side walls. The furnace is cylindrical in shape with two charging doors on opposite sides and the pouring spout in front. This arrangement is excellent for ease of charging and for patching, working slag, etc. Of the 181 furnaces of this make in use probably 175 are in basic operation, a great majority being used for the production of ingots and alloy metals.

The majority of Ludlum furnaces are in use either for gray iron refining or for making steels of the finest quality. This furnace is of an elliptical shape with two large doors, one extending the full width of each end. The walls slant up and out tending to retain the shape of the banks, and resulting in a long refractory life. The three electrodes are in a straight line down the center of the furnace, and are connected three phase. For the production of tool steels this furnace is giving satisfactory operating results, but seems to be handicapped in the rapid operation in a foundry.

The Greaves-Eathell furnace is unique in that it uses the principle of the conducting hearth implying basic operation only, as an acid refractory will not conduct the current. Magnesite when hot is a good conductor of electricity, and it is this fact upon which the furnace operations are based. The transformers are Scott connected, two phases going to the electrodes and the third being direct connected to the hearth. By an arrangement of switches the power is so arranged that at the start of operations when the hearth is cold, and non-conducting, all the current enters through the electrodes, the hearth connection being thrown in when a pool has formed. For fine steels containing high melting point alloys such as tungsten, etc., this probably offers advantages due to the bottom heating and to the agitation caused by convection currents emanating from the conductive hearth.

The Greene furnace has had a rather rapid increase in numbers during the past few years. The furnace is a rolling cylinder placed with the axis horizontal in each end, and a small pouring spout in front. The shape of the hearth therefore is oblong, the three electrodes

being in a straight line. The melting is slow for an acid furnace.

The 'Llectromelt or Pittsburgh furnace is typically an acid furnace designed for quick operation. It is three phase and is made high speed by using a high power input. The melting down voltage is about 180 and the refining or finishing about 120. Consequently heats can be melted in a short time. The normal power input is high for the slow refining necessary to good basic steel, but as this is a feature of the transformer rather than the furnace, it could be easily lowered. At present several basic installations of this furnace are operating satisfactorily, but best results have been obtained in the acid process.

Other furnaces operated successfully upon one or the other of the two types of lining mentioned might be enumerated, but those which were briefly noted were the makes with which the writer has come in contact.

Considers Points in Buying Pig Iron

OLD methods of grading and purchasing pig iron according to fracture and their limitations were discussed in an address by E. J. Lowry, Hickman, Williams & Co., Chicago, at a meeting of the National Association of Purchasing Agents held in Boston, May 22. At present pig iron is graded according to its silicon content which governs the price of this commodity. Mr. Lowry questioned the advisability of such a practice and cited a number of instances to prove that carbon and not silicon is the controlling influence that governs the standard of quality. He further discussed the good and bad action of the elements, sulphur, phosphorus and manganese in pig iron.

An important point brought out was that the chemical analysis of a pig iron does not solely control the product, and that in purchasing pig iron the quality is as important a consideration as the chemical analysis. Mr. Lowry advocated that the problems confronting the foundrymen should also be the problems of the purchasing agent insofar as they pertain to the quality of the raw materials used. By so doing the cost of material will be reduced which will be reflected in the selling price castings.

Mr. Lowry said:

Furnace men, foundrymen and purchasing agents threw up their hands in despair when an analytical basis for the buying and selling of pig iron first was advocated. Everyone said that the iron business was verging on ruin. This was far from true. It was only taking a short step forward by shaking its shoulders free of a shroud of mysticism of brands, fractures, etc. This mantle never has fallen completely free from the body of pig iron.

At that time little was known of the action of the elements in pig iron and there still remains a great deal to be learned. Investigations, in the old days, were based upon silicon in pig iron. It was found that this element *softened* the iron, and silicon was made the *money element* of this material. Pig iron was graded according to silicon content and four or five classes were established with a fifty point or 0.50 per cent spread in each grade. That which is commonly known as the No. 2 foundry, with a silicon of 1.75 to 2.25 per cent was called the base grade, which established the market price. For the other grades, a differential was added to or deducted from the base grade price in figuring their values. This practice exists at the present day.

The other elements, manganese, sulphur and phosphorus were and are specified according to the quality of iron desired.

We have accepted to a certain extent the information which has been so freely given to us as to silicon at the present time and when these data have been proved far from correct we still adhere to purchasing pig iron by silicon standard. If we were to be told that silicon does not actually soften iron, we would feel that our rights were being intruded upon, and we would cling steadfastly to our principles of the *money element* and advance all kinds of reasonings for our actions. Silicon does not actually soften iron. The primary function of silicon is to combine with the iron to harden it. The ultimate result is to act upon another element, carbon, to unstabilize its solution or suspension in the iron. When this instability is created, carbon is deposited as graphite and a soft casting or iron results.

Carbon need not be acted on by silicon in order to create the requisite instability as temperature controls to a great degree the reaction and time of cooling which acts as an adjunct to this factor. You might eliminate practically all of the silicon in an iron and yet produce a soft iron by employing these constituents. Malleable iron is a good example of one method and the new process for the production of *pearlitic* gray iron is a contrast to it. The latter has principles which allay the cooling times of a casting in a mold with a resulting low silicon, soft casting.

The fact of the matter is that we do not know very much about iron. The use of the names mentioned proves that. The iron itself, in all cases, has the same constituency. It's just plain iron. Its coloration is due to the carbon and the state in which it exists.

If the carbon is in combination with iron, the fracture is white. When it is in the form of graphitic carbon free from iron, the fracture is gray. Then, depending upon the percentage of graphite present, the iron becomes mottled.

There is nothing which will guarantee the quality of the iron content. Even brands fail on this score. The only way to find out positively about the iron content is by continued trial of a product. If one car is good, it does not necessarily mean that all cars will be good. Therefore, trials of materials should be in a suitable proportion in order to determine their suitability.

Sulphur is not as harmful as originally suspected. It is hard to keep sulphur low only to find that our competitors are running much higher percentages of this element without ill effect. If we could but convince ourselves that our sulphurs are within reason, for the type of product we are making, we could save trouble, worry and money. Many a good casting has been made with *off* sulphur iron. Yet, these irons go into discard while we sharpen our wits to fight for our disillusioned purpose.

Manganese is the aid to the use of high sulphurs. If we keep these elements in balance we can expect comparable results within limits. Manganese should be relatively high in all our raw materials because it insures against a great amount of oxidation taking place during the melting. The manganese in most castings should be kept between 0.50 and 1.00 per cent. In special cases, the formula—"Twice times the sulphur plus point fifteen," ($2 \times S + 0.15$) should equal the manganese in the casting. Manganese is a purifier of iron and as such should be welcomed when it is present.

The problems of our foundry superintendents should be our problems. In this competitive age in which we are living, when the demands upon our finished product have surpassed anything of which we ever dreamed ten years ago, it becomes important that the foundry superintendent is given quality in his raw materials. We should make a study of the science of the operations in the foundry, that in obtaining this quality we do not limit the all-important factors of bringing our business into the widest latitude of competitive fields.

To Manufacture Furnace

The Combustion Engineering Corp., Combustion Engineering building, 43 Broad street, New York, has taken over the rights for the Hermansen recuperating furnace. The furnace is said to be applicable to all melting and reheating processes, using oil, coal or any of the several types of gases, and is designed to affect a saving in the use of fuel. The company has organized an industrial furnace department to handle this class of business. Col. H. D. Savage, vice president, and authority on pulverized fuel, has assumed direct management of the department.

The main office of the Illinois Clay Products Co., has been removed from Oglesby, Ill. to the Barber building, Joliet, Ill.

Discusses Permanent Molds-II

Materials for Molds and Cores, Mold Design and Methods of Gating Are Described—Various Types of Commercial Alloys and Typical Castings Are Considered

BY ROBERT J. ANDERSON AND M. EDWARD BOYD

MANY patents have been taken out relating to the permanent mold casting of alloys. Although the process may be traced back to 3000 B. C., the early patents which began to appear in the 19th century dealt largely with the casting of stereotype plates and similar castings. Two typical early patents are United States patent 213,427, Jan. 23, 1878 and 314,395, Nov. 30, 1883. Earlier patents are on record. With the opening of the 20th century patents began to be issued in large numbers bearing upon every conceivable aspect of the problem. Molds are to be made of cast iron, steel and other metals, abrasive mixtures, graphite, refractories and other materials. Claims are based on mechanical principles of operation and for alloys to be cast. A list of a few United States patents relating to permanent molds is given in Table I and several early patents granted in foreign countries are listed in Table II.

Materials for constructing permanent molds are rather limited, the more readily available being cast iron, steels of various kinds and malleable iron. Graphite and various refractory substances have been tried but they have definite limitations. Gray iron is easier to shape and machine than steel, particularly alloy steel. Mild steel has been employed satisfactorily. Semisteel and malleable iron have been employed to a lesser extent. Alloy steels are expensive and the general tendency in permanent mold construction seems to favor gray iron.

Considerable discussion has developed as to the best composition of cast iron for use in permanent molds for nonferrous castings, but the writers are inclined to believe this feature has been accorded undue prominence. Quite satisfactory results have been secured while using ordinary run of foundry iron. Close grained iron seems to possess longer life and to show less distortion than ordinary gray iron.

Gray iron of the following analysis is stated to give satisfactory service: Combined carbon 0.13 per cent, graphitic carbon 2.90 per cent, silicon 2.15 per cent, sulphur 0.08 per cent, phosphorus 1.26 per cent and manganese 0.41 per cent.

Silicon Controlling Element

Gray iron molds, particularly when used for pouring alloys melting above 600 degrees Cent., may warp, grow and become distorted in service and such growth and distortion is affected markedly by the silicon content. Rugan and Carpenter[25] [26] [27] [28] have shown that the direct cause of growth of gray iron is due to the expansive force exerted by the oxidation of iron silicide. Nitrogen and hydrogen increase growth when the silicon content is between 1.00 and 3.00 per cent. Phosphorus, manganese and sulphur in increasing amounts tend to diminish growth. Unless graphite is present silicon of itself is innocuous. White irons are not machinable and almost always they crack on heating so that the only alternative molds for ferrous metals are made of steel.

Carpenter[26] states that an iron containing 3.00 per cent carbon, 0.60 to 0.70 per cent silicon and 0.50 per cent manganese does not grow; while one containing 2.50 per cent carbon, 1.50 per cent manganese, 0.50 per cent silicon and 0.10 per cent each of sulphur and phosphorus, contracts about 0.40 per cent after repeated heating. Objection has been made to high phosphorus content on the ground that the iron-phosphorus eutectic has a low melting point. The phosphorus in gray iron usually is present as a ternary eutectic containing

[25]Rugan, H. F. and Carpenter, H. C. H., Growth of Cast Iron After Repeated Heatings, part 1 *Journal Iron and Steel Institute*, Vol. 80, No. 2, 1909, pages 29-125.

[26]Carpenter, H. C. H., The Growth of Cast Iron After Repeated Heatings, parts II, III and IV, *Journal Iron and Steel Institute*, Vol. 83, No. 1, 1911, pages 196-229.

[27]Rugan, H. F. The Growth of Cast Iron After Repeated Heatings. *Journal Iron and Steel Institute*, parts V and VI, Vol. 86, No. 2, 1912, pages 311-319.

[28]Carpenter, H. C. H., Further Notes on Cast Iron Growth; *Proceedings*, Staffordshire Iron and Steel Institute, Vol. 32, 1916-1917, pages 31-47.

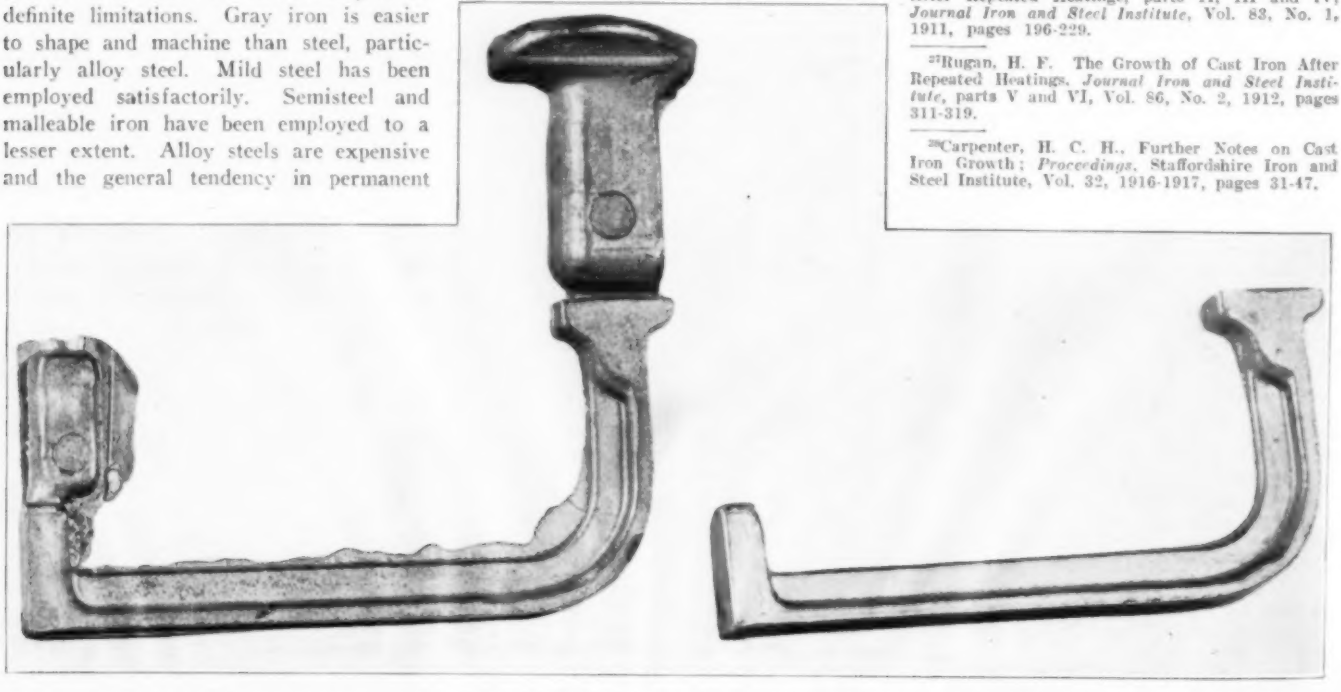


FIG. 16—SMALL CASTING MADE IN A PERMANENT MOLD FROM A 92-8 COPPER ALUMINUM ALLOY. AT THE RIGHT THE CASTING IS SHOWN CLEANED, WHILE AT THE LEFT IT IS SHOWN WITH RISER AND GATE ATTACHED

iron 91.20 per cent, carbon 2.00 per cent and phosphorus 6.80 per cent. The melting point of ordinary gray iron is reduced about 27 degrees Cent. for each per cent of phosphorus present.

Generally speaking the life of a gray iron mold is dependent, not so much on the number of castings produced as upon the number of times it is allowed to cool to ordinary atmospheric temperature. Growth of cast iron is accelerated by alternate heating and cooling and the strains set up by this treatment are more destructive than the erosive effect of the liquid alloys. It has been estimated that a mold used continuously will outlast four molds used only intermittently. Usually the gates and risers are the first points to show signs of disintegration although some molds have an active record of five years and still in good condition. However, usually it is necessary to renew the gates and runners by blocking-in with new iron and then recutting the passages.

Apply Mold Washes

Many attempts have been made more or less successfully to apply refractory coatings and washes to the mold surface in gray iron for the purpose of preventing erosion and also in molds where steel castings are poured. Coatings that are easily applied, usually are unstable and those that are refractory will not adhere to the surface of the mold. In British practice a number of washes have been used including seal oil, lard oil, linseed oil, tallow, etc., mixed with graphite. Where carbonaceous dressings are not desired, Johnson[20] recommends an emulsion of bone ash and water and he also suggests a dressing made by burning a smoky flame against the mold surface to deposit amorphous carbon. A mixture of lime and sodium silicate or of refractory clay and sodium silicate has been employed in American practice. Alundum, carborundum and various other refractories have been tried.

Cast iron cores usually are employed for iron castings where the internal shape is favorable. They may be collapsible or in one piece. In other cases it is necessary to employ sand cores. Steel or wrought iron cores are not as satisfactory as cast iron. Alloy steel, chrome-vanadium and high speed tungsten steel has been found satisfactory for nonferrous alloys and mild steel also has been used. Alloy steel cores are considerably more expensive and more difficult to shape and machine than ordinary steel, but they withstand usage much better and last longer.

Each type of casting to be made in a permanent mold presents a separate problem of itself and no general rules can be laid down to insure success. A certain amount of experimental work, particularly in connection with gating, may be necessary with a new mold. The first item for consideration is the relation of the size and thickness of the mold body to that of the proposed casting.

The object in nonferrous molds is to produce a chilling or densening effect on the casting. This feature is to be prevented on gray iron castings and is accomplished either by pouring the iron into heated molds or by removing the casting immediately after it has solidified, or by employing an insulating refractory lining. Regulation of chilling effect in nonferrous alloys is effected by varying the mold and pouring temperature. For an aluminum alloy casting the size of a 4-inch diameter motor piston, the mold wall thickness is ½ to ¾ inch and larger castings may require thicker molds. Thin walls warp too easily and do not permit maintenance of uniform temperature, consequently it is better to have a mold heavy than light. At the same time it is well to bear in mind that heavy molds are more difficult to operate. The shape of the mold body will depend upon the shape of the part to be cast, although the general tendency is to make simple geometrical shapes square, rectangular, or circular.

The surface of the mold cavity for cast iron need not be as smooth as for brass or aluminum alloys since ordinarily the finish on iron does not need to equal that on nonferrous castings. Molds for cast iron should be thicker than those for nonferrous alloys to better resist the warping effect of high temperatures. Obviously heavier molds must be equipped with better fittings. The pouring temperature for an alloy cast in a permanent mold is higher than where poured into a sand mold.

Generally speaking it is advisable to provide the mold with ejector pins. They serve a useful purpose where the castings show a tendency to stick to the surface of the mold particularly if the mold surface is rough. Difficulty in operating the mold may be due to lack of draft or to many core pieces which must be placed before the casting is poured. The removal of a casting from a permanent mold takes more time normally than the removal of a die casting. The joints between mold sections should be perfect, otherwise small metal fins will form and prevent rapid ejection of the casting.

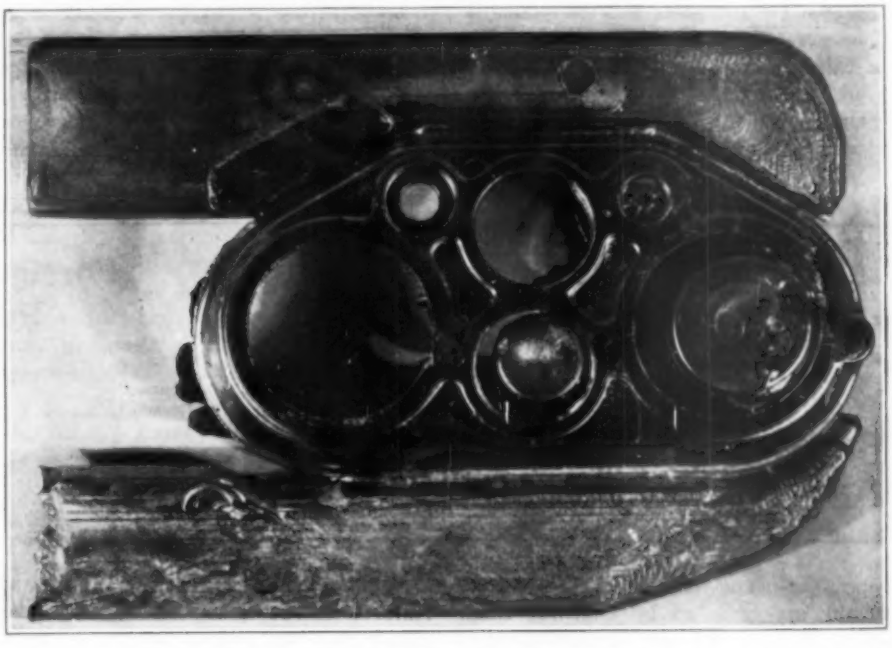


FIG. 17—INSTRUMENT PANEL CASTING MADE BY THE PERMANENT MOLD PROCESS FROM A 92 -8 COPPER ALUMINUM ALLOY. THE GATE AND RISER ARE SHOWN ATTACHED TO THE CASTING

Locating The Gates

The position of gates and risers on castings of simple and regular form is not especially important, but where account must be taken of bosses, webs, lugs, flanges and other irregularities, the best general plan is to gate close to the thickest section and provide small risers near other heavy sections. However this rule is flexible. Often the casting must be placed in a certain position in the mold and thus prevent gating at the most advantageous point. The authors have tried various methods of gating

[20]Johnson, F., The Casting of Nonferrous Metals in Chill Molds; *Proceedings*, British Foundrymen's association, Vol. for 1915-1916, pages 140-176.

and prefer a gate which feeds along the side or near the top of the mold.

With bottom feeding molds, the metal first deposited and partly chilled is forced up into the mold cavity by the rush of hot alloy behind it and this first deposited alloy never really is fluid enough to fill the cavity but shows in cold shuts and overlaps. The ideal gate is one which fills the mold cavity with as little disturbance or splashing of the alloy as possible. In some cases it is not possible to determine the size or position of the gates until the mold actually is tried out by pouring the casting through some form of gate. Generally it is recognized as good practice to decide on a method of gating and then cut the gates and risers smaller than necessary. The cavities later may be enlarged as dictated by actual experiment.

During preliminary tryout of a mold it may be observed that certain areas of the casting do not fill out or that *draws* appear at some points. These defects usually are remedied by attaching small shrink pads to the casting through narrow feeders. If the defective spots are situated in a position where this remedy cannot be applied, the height of the heads may be increased. In casting high contraction alloys, cracks may develop at the junction of thick and thin sections. Chills may be placed in the mold in contact with the thick section to increase the cooling speed. These chills in an iron mold may be made of brass or copper since these metals have a greater thermal conductivity than iron.

The principle involved in the construction of a collapsible core is the same as that followed in making collapsible mandrils for spinning hollow ware. Undercut areas are taken care of by using a central core piece around which the actual interior contour of the casting is formed by additional sectional pieces. This method permits withdrawal of the outer core pieces from the mold after the center core piece has been removed. With collapsible cores a taper of ⅛ to ¼ inch per foot is allowed to permit easy removal from the mold.

Sand cores are used in connection with many types of permanent molds, but they present several disadvantages, particularly where nonferrous metals are poured in the molds. Sand cores do not give as satisfactory a surface finish as steel cores to the interior of a casting. For some classes of work this makes them undesirable. Further, cavities made with sand cores are not accurate to close dimensions.

Permanent molds may be vented by cutting small grooves 1/16 to ⅛ inch wide and 0.004 inch or more deep across the core and mold joints from points which appear to require special venting. As a rule simple castings are sufficiently vented through the risers. Loose cores and joint faces also serve as exits for the gas.

In preparing a permanent mold it is advantageous from the point of view of economy in machining to construct the mold pattern in a manner to conform as closely as possible to the shape of the desired finished mold. The cavity then may be finished by a minimum amount of machining. The important features to be considered outside the gating and the general aspect of mold design are the obtaining of a smooth finish on the surface forming the cavity and making proper allowance for contraction.

So many factors affect the contraction of the casting that no specific rule can be laid down to insure the casting coming out to dead size the first time the mold is tried. It is customary to allow 0.1 per cent variation for aluminum alloys in general, 0.07 per cent for brass and 0.05 per cent for zinc alloys.

In the nonferrous field the permanent mold process has been applied extensively to the production of aluminum alloy castings. The requirements of the automobile industry for miscellaneous castings in aluminum alloys offers a particularly adaptable field for permanent mold castings in large numbers. Tensile properties of aluminum alloys when chill cast are considerably higher than when sand cast. Further, aluminum alloys poured in permanent molds are sound and free from porosity.

Castings now poured commercially from aluminum alloys in permanent molds include pistons, instrument panels, brakeshoe arms, door handles, small gear housings, steering wheel spiders, small hardware and other parts. Small castings for electrical equipment are poured in permanent molds and larger castings, gear casings and crankcases from 20 to 150 pounds have been cast in this manner. Aluminum alloy automobile wheels have been cast successfully in permanent molds, but so far have not been adopted to any extent.

Commercially the maximum weight of permanent mold castings poured from aluminum is about 25 pounds and the minimum weight is 1 ounce, although castings have been made by this process weighing up to 200 pounds. The minimum section is ⅛ inch and the limit of accuracy may be held within plus or minus 0.01 inch. Unless the casting is small and of simple design, difficulty sometimes is encountered in keeping within close size limits, due to uneven contraction which in turn is caused by variation in section sizes and thicknesses. Where the casting is to be machined extra metal to the extent of 1/32 or in some cases 1/16 inch is allowed. A slight taper usually is provided on long cored holes. The taper afterward is corrected by a reamer. Weight tolerances are held to plus or minus 2 per cent.

Small castings in aluminum alloys may be gated two or more together for increased production. A small aluminum alloy casting made by the permanent mold process is shown in Fig. 16. The pouring gate and riser may be noted attached at the left while on the right the same casting is shown as it appeared ready to ship. An instrument panel for a motor car is shown in Fig. 17.

Various aluminum alloys are employed for permanent mold castings, including the ordinary 92-8 aluminum-copper alloy and other aluminum-copper alloys containing from 4 to 14 per cent copper. Special alloys sometimes are employed for these castings. These alloys include silicon bearing aluminum alloys, nickel bearing aluminum alloys, and aluminum-copper-magnesium alloys. Little work has been done to develop the most suitable aluminum alloys for permanent mold

United States Patents Issued on Permanent Molds

Table I

U. S. Pat. No.	Date	U. S. Pat. No.	Date
695,091	Mar. 11, 1902	1,097,847	Oct. 26, 1910
714,061	Jan. 2, 1902	1,104,037	Oct. 22, 1970
841,279	Jan. 15, 1907	1,019,905	Mar. 12, 1912
859,612	July 9, 1907	1,360,655	Nov. 30, 1920
904,759	Mar. 3, 1908	1,368,455	Feb. 15, 1921
1,042,092	June 3, 1910	1,410,776	Mar. 28, 1922

Foreign Patents Issued on Permanent Molds

Table II

Country	Pat. No.	Date
Germany	119,643	Jan. 16, 1900
France	338,645	Nov. 13, 1903
France	479,158	Feb. 28, 1916
England	105,101	Mar. 29, 1916
England	192,978	April 11, 1923

castings, with the single exception possibly of alloys for pistons. At present the only points in connection with aluminum alloys for permanent mold castings on which operators are agreed are that it should be fluid at a temperature moderately above the melting point, should only contract slightly, should exert little solvent action on the mold and possess considerable strength in the solid state and while at high temperature.

Small castings in 67-33 brass and similar alloys may be cast successfully in permanent molds. However, the fairly high melting temperature and corrosive action of these alloys exert a deteriorating influence upon cast iron molds and the molds become inaccurate after they have been used from 2000 to 3000 times. Unless considerable saving is effected in machining cost and from increased production these alloys had better been cast in sand.

Commercial Possibilities

High-zinc copper alloys, especially at high temperatures are erosive on iron, but alloys of the bronze type with low zinc content may be used with comparative safety. Dynamo brush holders, gear wheels and various other small castings have been made on a commercial basis from brass poured in permanent molds. Gun metal and phosphor bronze bars to be used in automatic machine work for bushings and liners have been cast in permanent molds. Bars 1¼-inch diameter and from 3 to 6 feet in length are prepared for this purpose. Aluminum bronze is cast commercially in gear wheels and small parts for electrical equipment. It is stated that gear wheels weighing from 10 to 40 pounds and with teeth conforming to an accuracy of plus or minus 0.001 inch are now produced in permanent molds. According to reports the life of a mold employed for this purpose ranges from 5000 to 30,000 castings.

All white metal alloys may be cast by the permanent mold process, but in general the die casting method is more suitable. Zinc castings including gear wheels and *crows feet* for wet cells are cast commercially. Permanent mold casting is useful for these alloys where a white metal alloy is to be cast on to a cast iron or steel body.

In the iron trades various articles are made by the permanent mold process. Plow points, brake shoes, soil pipe, pipe fittings, projectiles, mine car wheels, bevel gears for agricultural machinery, grate bars, hammer blocks, and many others are made in this manner. The usual run of foundry iron is used for nearly all the castings listed. Little work so far has been done in cast steel, but there seems to be no particularly valid reason why this metal should not be cast successfully in permanent molds. The development of the method for casting gray iron has been hindered by difficulties encountered in preventing excessive chilling of the iron. Various methods have been devised and practiced for overcoming the chill effect. Molds have been heated, molds have been lined with refractory material, and the chilled castings have been annealed.

In the process devised by Custer[20] chilling is avoided by taking advantage of the fact that an interval of time elapses between the temperature at which the metal sets and that at which it begins to chill. The casting is removed from the mold during this period, which ranges from 2 to 10 seconds depending on the thickness of the metal section.

[20]Custer, E. A., The Permanent Mold and Its Effect on Cast Iron; THE FOUNDRY, Vol. 45, 1909, pages 121-124.

Unify Specifications for Cast Iron Pipe

At a conference in New York of the American Engineering Standards committee on June 5, it was decided that a general program of unifying existing specifications for cast iron pipe and into a consistent set of nationally recognized specifications should be undertaken.

Consideration of the subject was introduced by a paper by W. G. Hammerstrom, which outlined the present practice, not only of various organizations who have issued formal specifications, such as the American Water Works association, the American Gas association and the American Society for Testing Materials, but indicated the more usual commercial departures from and extension of these standards. Mr. Hammerstrom also outlined the foreign practice, with particular reference to the work of the British, French and German cast iron pipe industries.

After a very thorough discussion of the various problems concerned in the proposal to bring about national uniformity in the industry, agreement was reached on the following scope for this work: Unification and development of specifications for cast iron pipe, including materials, dimensions, pressure ratings; methods of manufacture, including such new developments as centrifugal casting, in so far as they may be necessary to secure satisfactory results in preparation of workable specification; elimination of unnecessary sizes and varieties; consideration of the possibility of developing a co-ordinated scheme of metallic pipe and fittings applicable to all common mediums, possibly along the lines of the work being carried on in Europe on the same subject; and methods of making up joints in so far as they are determining as to the dimensional design of cast iron pipe.

The types of cast iron pipe under standardization are to include: Flanged pipe; flanged and bell mouth fittings and wall castings; pipe elbows, tees, Y's, return bends, and other fittings not now included in standard lists; cast iron pipe threaded for flanges or couplings; soil pipe and other light types of cast iron pipe and fittings.

The work will be co-ordinated with that of the existing sectional committee on pipe flanges and fittings, which already is well advanced under the sponsorship of the American Society of Mechanical Engineers, the Manufacturers Standardization Society of the Valve and Fittings Industry and the Heating and Piping Contractors National association.

It was recommended that the work be carried out by a sectional committee under the auspices and procedure of the American Engineering Standards committee, and under the joint sponsorship of the American Gas association, the American Water-Works association, and the American Society for Testing Materials, and formal recommendations to this effect were made to the American Engineering Standards committee.

Horse Shoes Not Classed as Foundry Scrap

Question: We have been using about 5 per cent steel scrap in the mixture from which we pour a general line of railroad repair castings. Recently we have noted an item in a technical paper claiming that for certain castings good quality scrap iron such as horse shoes may be used up to 35 per cent.

Answer: We do not understand how you gained the impression that horse shoes are listed as foundry scrap iron. Horse shoes are made from a fairly low carbon steel and whether they are old or new they still are steel and therefore a long way removed from the product of a cupola. They are used in cupola mixtures in the same manner that steel in any other form is used and in a proportion to suit local conditions. An addition of 5 or even 10 per cent steel requires no extraordinary skill on the part of the melter, but where an attempt is made to add over 20 per cent steel, trouble will ensue unless the melter has a specialized knowledge of cupola operation.

E. M. Roubieu first vice president, Tropenas Co., New York, who has had charge of the Rio de Janeiro offices of that firm for the past four years, is visiting the United States. He expects to return to South America in the late summer.

Economical Cupola Melting

Kinds of Iron Melted, the Quality of the Coke, the Air Supply, the Limestone and the Cupola Linings Are Important Factors Governing Fuel Economy in the Foundry

BY H. VAN AARST

ECONOMICAL fuel consumption is an important problem at present due to the large demand accompanied with decreased production following the war and recent strikes. As a large quantity of fuel is needed in the foundry industry, the various factors affecting fuel economy in the foundry will be discussed. The various kinds of iron have a direct bearing on the amount of fuel used. Hard iron, with a low temperature of silicon and manganese has a higher fusing point than soft iron. It requires a higher temperature to liquify. Large pieces of iron are more difficult to melt than small pieces. Iron covered with sand will melt less easily than clean iron. Moreover, the required temperature of the metal will depend upon the sizes of the castings to be made. Thin castings need an iron of higher temperature than heavy ones. The transportation of liquid iron in the foundry also must be taken into consideration. In the first instance, the foundryman must take into consideration the purpose for which the melted iron is to be used, after which the quantity of coke must be determined.

The different temperatures are approximately as follows: Cold iron, 1200 degrees Cent.; warm iron, 1260 degrees Cent.; hot iron, 1320 degrees Cent.; very hot iron, 1380 degrees Cent.; extraordinarily hot iron, 1450 degrees Cent.

The quantity of coke must be determined. Good coke is hard and coarse, and consists of 84 per cent carbon, 10 per cent ash, 1 per cent sulphur, and 5 per cent water. Bad coke is porous, and the specific gravity is less. It also has a higher percentage of ash and sulphur.

The combustion of coke may take place in two ways. When there is much air, and therefore much oxygen, one part of carbon combines with two parts of oxygen ($C + O_2 = CO_2$).

From this combustion carbon dioxide is produced with the evolution of 8080 calories. If there is too little air and too little oxygen, 1 of oxygen combines with 1 of carbon ($C + O = CO$), producing carbon monoxide with an evolution of 2473 calories, or only one-third of the calories units developed by full combustion. Thus, it is of the utmost importance to accomplish the formation of carbon dioxide as much as possible.

It is not so easy to have a sufficient air supply as it seems to be, as carbon dioxide cannot exist at any temperature. The escaping gases of the cupola chiefly consist of nitrogen, carbon dioxide, and carbon monoxide. Neglecting the nitrogen and considering only the carbon dioxide and monoxide, it is known that both can exist up to 400 degrees Cent. The higher the temperature becomes, the less carbon dioxide will be formed. This goes on up to 1000 degrees Cent., at which temperature they cannot exist at all.

However, there are two opposite factors, namely the coke requiring a large air supply to get the greatest possible useful efficiency, and the peculiarity of the carbon dioxide to dissociate at a temperature above 400 degrees Cent.

Coke Properties Important

The mechanical properties of the coke are influencing factors. Hard, coarse coke imposes more resistance to the pressure of the upper layers of iron, coke and limestone than porous coke. More space will be occupied by the latter. With coarse coke more oxygen may pass than with porous coke, and less surface of carbon is exposed to the passing oxygen. The carbon dioxide combination, to be associated with good melting process, will assume its correct position, just as is required. Porous coke will give the opposite result, as the oxygen in passing meets a large surface of carbon, giving a combination of carbon monoxide as a result. This uses more carbon with the same quantity of oxygen, both more oxygen and coke being required.

In many foundries it is usual to make charges of 500 pounds, it being considered better to use 1120 pounds. The latter quantity of coke for each charge will give a better result when using hard coke. It will stand pressure and friction in the cupola better, and facilitate the descent of the material. The pulverization will not be so great. The quantity of coke needed in a well conducted furnace varies between 8 to 10 per cent of the quantity of iron to be melted. It must be understood that this percentage also depends upon the quality of iron and coke used.

An important factor when melting is the quality of limestone. Liquid slag proves that sufficient limestone has been used and thick slag indicates the contrary. A thick, viscous slag may be disadvantageous, because the tougher the slag the easier it fastens itself near the tuyeres or into the channel of the receiver, in which case the melting process will be disturbed.

The thin, fluid slag is of great importance. The molten iron looses some of its sulphur, chiefly rich sulphur manganese alloys, which are lighter than molten iron and rise to the surface. A fluid slag will take up these impurities. It is worth recommending to tap the slag often, to prevent it from clinging to the lining and to keep it fluid and fresh. The correct color for cold slag is glittering black and it should be very brittle. If it is dead-black, hard, and contains iron, something is wrong with the melting process. Often the fracture of the slag is yellow green. The quantity of limestone necessary when melting depends upon the quality of coke, the kind of iron to be melted, and the lining of the cupola. Generally speaking, one may use 25 to 30 per cent limestone of the quantity of the melting coke.

Coke, limestone and the air supply form a triple alliance, completing one another during the melting process. With an open fire with natural draft the air supply constantly regulates itself with incomplete combustion. This is by no means the case when iron is melted with forced draft.

The necessity for using an exact quantity of air to obtain the most economical result of a good combustion is well known. Insufficient air supply gives an imperfect combus-

From a paper presented at the Newcastle conference of the Institute of British Foundrymen, Newcastle-on-Tyne, England, June 4, 1924.

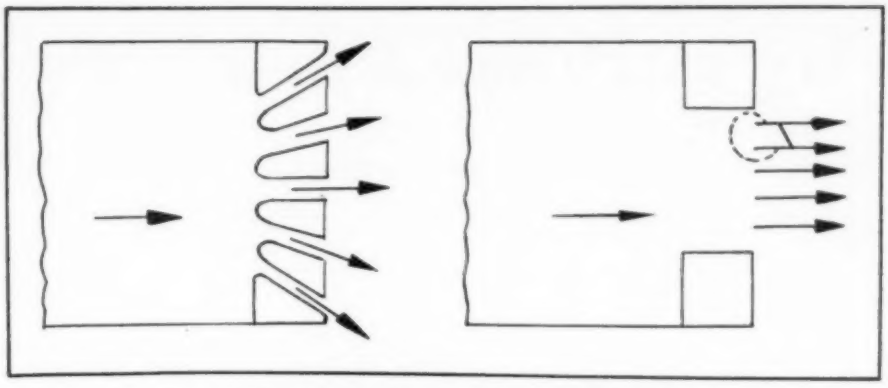


FIG. 1—CORRECT METHOD FOR AIR TO ENTER THE CUPOLA. FIG. 2—WRONG METHOD FOR AIR TO ENTER THE CUPOLA

tion of coke. On the other hand, excessive air supply oxidizes the iron and causes metallic losses. With an accelerated air supply the gases leaving the cupola have too high a temperature. A perfect combustion of the coke practically has been found by using 8 to 10 cubic meters of air for 1 kilo of iron.

To calculate the amount of air used in the cupola the speed and pressure of the air supply must be known. The speed may be controlled by using a pitot tube which is filled with water as near the tuyeres as possible. Instead of the pitot tube, there also are self-registering meters. One advantage is that they indicate all fluctuations of the melting process and control the actions of the furnace man.

The cupola construction is shown in Fig. 3, divided into three main parts—charging shaft, heating zone, and melting zone. The bottom of the charging channel is enlarged to prevent the difficulty of *hanging* of the material. Wherever the lining has burnt away it is necessary to rebuild as soon as possible to prevent this occurring. The escaping gases also will be more free to leave the cupola chimney. The heating zone has a larger diameter than the upper part for two reasons, namely, each time the charges fall on the enlarged coke bed the escaping gases are not obstructed and meet less opposition, and above the melting zone there is a lower temperature with this construction than with a straight lined cupola. The formation of carbon dioxide is promoted, the heat is better utilized.

The iron is melted in the melting zone and every obstacle which may take place before entering this part of the furnace is removed. Here the coke burns, the iron melts, and slags are formed. There is a continual movement, the heated gases going upwards to the chimney, the melted iron running down to the bottom and receiver. The slag runs slowly to the bottom, often giving the furnace man great trouble, especially when it adheres to the tuyeres, obstructing them or the channel to the receiver. To prevent these difficulties, Fig. 3 shows how the tuyeres are built into the lining. The slag may pass these holes without causing any trouble.

Foundrymen must be sure that on the side of the receiver no difficulties arise from slag adhering to the tuyere. This always cannot be ascertained from the opposite side of the tuyere, as the coke lying near will be soon chilled by the blast. The dripping slag will cool there, and gradually the tuyere will be filled with slag and noncombusted coke.

To prevent this difficulty the entering air must be divided as shown in Fig. 1. Fig. 2 shows the wrong method.

The coke lying in front of this hole also will burn much better. Now a regular air supply is secured which is of the greatest importance to a good melting process.

A smoky fire shows the incomplete combustion. While colored flames at the charging door during the melting process indicates the incomplete combustion. These gases arise from too little air supply.

To secure perfect combustion look at the tapped iron to see if it is hot enough. If this is not the case, raise the air and coke supply.

If possible try to regulate the combustion in such a way as to obtain a transparent light blue colored flame at the charging door. The fuel consumption is but a little larger, but a regular melting process is more certain and in cases of breakdown the metal may stand a little time.

A yellowish rose flame shows that the temperature above the melting zone is high, resulting in heat loss.

It has been the intention to show an economical method for fuel consumption in the cupola, and to make it understood how much there is to be done in this respect.

The iron to be melted determines the quantity of coke, the coke determines the air and limestone supplies, while the limestone influences the combustion. The height of the cupola is still another factor.

To save coke it is necessary to know first of all what happens during the melting process. The knowledge of this subject is incomplete.

The Chicago Pneumatic Tool Co., New York, has opened a branch office at 210 South Jefferson street, Dallas, Tex. J. O. Bailey is in charge.

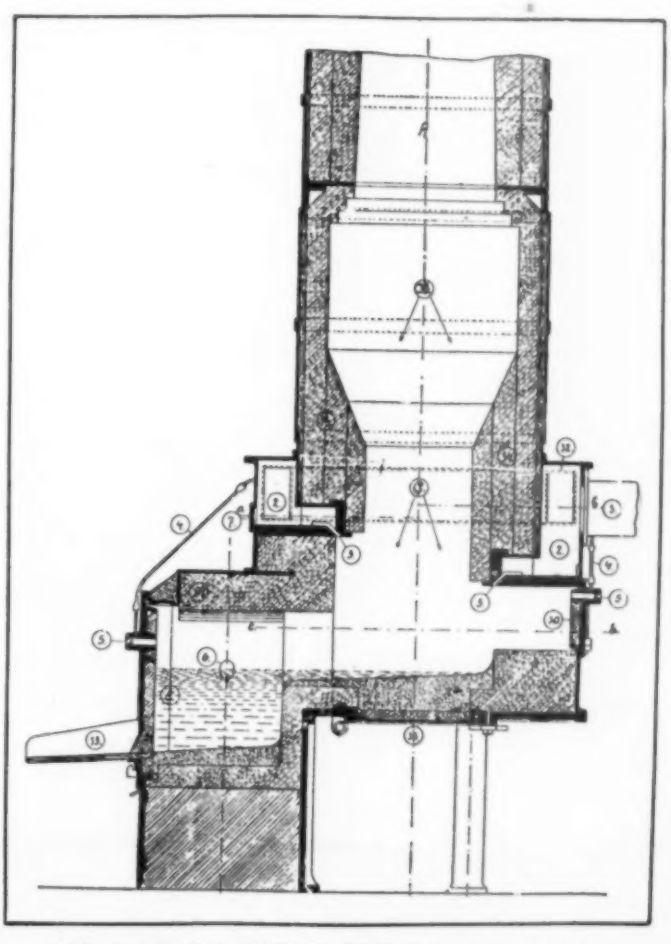


FIG. 3—CUPOLA HAVING RECEIVER FOR METAL

How and Why in Brass Founding

By Charles Vickers

Gasoline Pump Valves

We would like a mixture for gasoline pump valves. We are now using standard red brass eighty-five, three fives, with the addition of one per cent of antimony. Should the seat be harder than the poppet or vice versa, or should they both be the same? Also can we get our castings all one color by sand blast, or acid?

It is our opinion the eighty-five, three fives would be better with the one per cent antimony omitted. This metal is useful in babbitts, but the good effect it may have on brass and bronze is more than offset by the weakening influence. The following alloy sometimes is preferred for gasoline burners:

ALLOY FOR BURNERS

	Per cent
Copper	79
Zinc	15
Lead	3
Tin	3

To this mixture is added cold and in the bottom of the pot 1 ounce of 15 per cent phosphor copper.

We do not know whether it is customary to make the seat harder than the poppet or not, but common sense suggests that the part most costly to duplicate should be made of the more lasting metal, as the worn and cheaper part can be more easily renewed.

Melting Brass Turnings

We will greatly appreciate your advice in regard to what is now considered the best method of handling and melting brass turnings which accumulate from the machining of brass castings. We have heard of various methods used by foundries, and would like to get all possible information in regard to this subject.

There is no standard method of handling and melting brass turnings as every foundry does this in the manner best suited to the melting equipment, and their own convenience. Where the melting is done in crucible furnaces, some operators like to start the melting by charging the turnings into a molten bath of metal in the bottom of the crucible. Others fill the crucible with the turnings let them sink down under the heat, continuing to charge more on top until the crucible is filled with metal. When using crucibles it will assist materially to use deepeners on top. These deepeners must fit closely to the crucible or the fine brass will sieve down into the fire through any openings in the bottom edge of the deepener.

The speediest way of melting turnings is to use a noncrucible furnace as large heats can be melted in a short time. One of the more modern methods is to use an electric furnace located under a mezzanine floor through which the turnings are charged into the furnace by shoveling them down a funnel that connects with the up-turned mouth of the furnace. The electric furnace is suited particularly to running down turnings, as they are not oxidized during the melting, and aluminum, iron, and impurities of all kinds may be removed, thus producing a clean, dense ingot which after analysis may be remelted and brought to any desired composition.

Benedict Nickel

We would like to know the formula for Benedict nickel. We manufacture builders' hardware and desire a good mixture for a white brass having a copper base, as we understand that eastern concerns use such an alloy for lavatory parts, which polishes white.

The following is the formula of Benedict nickel:

BENEDICT NICKEL

	Per cent
Copper	80
Nickel	20

A white alloy extensively used is made up as follows:

WHITE ALLOY

	Per cent
Copper	50
Nickel	15
Zinc	35

To every 100 pounds are added 2 ounces of aluminum.

Name Plate Mixture

We would like to obtain a mixture for a bronze suitable for casting name plates.

The following mixture is much used for name plates:

NAME PLATE MIXTURE

	Per cent
Copper	87
Zinc	8
Tin	3
Lead	2

Frees Castings of Dross

We are making thin circular castings of yellow brass and use aluminum as a flux but are unable to get them free of dross as you will note by examination of the samples we are sending you. Competitive castings are free of dross. We also enclose one of these with our samples for your inspection. We have tried different ways but are unable to run the castings with metal free of aluminum. Is the dross caused by the aluminum? Our plater complains of being unable to plate the castings, as the plating will not take. Can you give any reason for this?

The aluminum causes the dross. It has the same action on metals as soap on water; that is, it causes a lather. The lather in the case of metals has no time to subside so it remains as lather which is squeezed against the sides of the mold, and being a frothy substance the natural result is that voids are left in the metal. When this effect of aluminum is fully understood the futility of gating the castings in the same manner as for red brass will be realized.

Red brass castings are always gated in the easiest and most obvious manner; one that gives the least trouble to the molder. A copper alloy containing from 35 to 40 per cent zinc, whether lead is present or not, must be *fluxed* with aluminum, or it cannot be run. The competitive casting shows that such aluminum fluxed alloys are being used, although the sample sent is a poor casting, and one that will never finish perfectly. The makers avoided the dross but forgot about the shrinkage, which also has to be avoided. Try to get the foreman interested in flowing soapy water (such as used for blowing bubbles) into glass vessels without lathering, and he will have had a schooling that will pay dividends. The fault is not with the alloy, everybody is using it. The getting of good results is strictly up to the foundry foreman. One of the castings we note was made using silicon in place of aluminum. Silicon produces less dross than aluminum, but does produce some dross, and in this case all of the dross was in the casting, not in the gate where it should be. Run one or two molds *up hill*, instead of *down hill;* even if the castings fail to run there will be an object lesson.

Cut to this point

TYPICAL ANALYSES OF MISCELLANEOUS COMMODITIES USED IN FOUNDRY PRACTICE

By J. M. Quinn

Name	Boron	Carbon	Manganese	Sulphur	Phosphorus	Silicon	Iron	Aluminum	Copper	Oxygen	Cobalt	Tungsten	Source of Data	
Symbol	B	C	Mn	S	P	Si	Fe	Al	Cu	O	Co	W		
ALLOYS														**ALLOYS**
Boron—Ferro	32.75	2.87	.....	0.030	0.005	.....	.....	.....	.....	.....	.....	.....	Bureau of Mines, Bulletin 77, Washington,	1916
Boron—Ferro	17.00	.....	.....	.....	.....	1.00	.....	6.00	.....	.....	.....	.....	Metal & Thermit Corp., New York City	1921
	Chromium Cr													
Chromium—Ferro	65.90	8.58	0.44	0.020	0.020	1.26	23.44	0.18	.....	.....	.....	.....	Illinois Steel Company, Chicago, Ill	1909
Chromium—Ferro	64.17	2.34	0.21	0.023	0.020	0.38	32.47	0.13	.....	.....	.....	.....	Illinois Steel Company, Chicago, Ill	1909
Chromium—Ferro	70.05	5.46	.....	0.060	0.047	.....	.....	.....	.....	.....	.....	.....	National Alloy Corp., Philadelphia, Pa	1921
Chromium—Ferro	60.05	0.20	.....	.....	0.136	0.87	.....	.....	.....	.....	.....	.....	Metal & Thermit Corp., New York City	1921
Chromium—Ferro	60.25	0.12	.....	.....	.....	1.22	.....	1.88	.....	.....	.....	.....	Metal & Thermit Corp., New York City	1921
Chromium—Ferro	63.65	4.08	.....	.....	.....	4.05	.....	.....	.....	.....	.....	.....	U. S. Ferro Alloy Co., Niagara Falls, N. Y.	1921
Chromium—Tungsten Ferro	50.00	2.00	.....	.....	.....	.....	25.00	.....	.....	.....	.....	22.00	Electro Metallurgical Sales Corp., New York City	1922
Iron—Basic Pig—Lake Ore	.....	4.03	1.30	0.027	0.138	0.98	.....	.....	.....	.....	.....	.....	No. 5 Blast Furnace, Illinois Steel Co., Gary, Ind	1914
Iron—Basic Pig—Adrian	.....	4.00	{0.60 to 0.90}	{Under 0.010}	{0.50 to 0.70}	{4.00 to 6.00}	.....	.....	.....	.....	.....	.....	Adrian Furnace Co., Du Bois, Pa.	1920
Iron—Basic Pig	.....	3.73	0.30	0.015	0.800	2.40	.....	.....	.....	.....	.....	.....	Adrian Furnace Co., Woodward, Ala	1915
Iron—Basic Pig	.....	3.95	1.68	0.064	0.202	1.09	.....	.....	.....	.....	.....	.....	Frodingham, England	1915
Iron—Acid Pig—Low Phos	.....	{3.50 to 4.00}	{0.40 to 0.60}	{Under 0.035}	{Under 0.035}	{1.00 to 2.00}	.....	.....	.....	.....	.....	.....	Hickman-Williams Co., Chicago, Ill	1910
Iron—Acid Pig—Low Phos	.....	3.65	0.46	0.019	0.037	1.79	.....	.....	.....	.....	.....	.....	Thomas Furnace Co., Milwaukee, Wis	1914
Iron—Acid Pig—Low Phos	.....	3.75	1.40	0.032	0.050	2.94	.....	.....	.....	.....	.....	.....	Gartsherrie Hematite, England	1910
Iron—Swedish Charcoal Pig	.....	{2.00 to 3.75}	{0.20 to 0.80}	{0.010 to 0.015}	{0.020 to 0.025}	{0.40 to 0.60}	.....	.....	.....	.....	.....	.....	Debevoise-Anderson Co., New York City	1921
Iron—Ingot	.....	0.01	0.003	0.015	0.001	0.002	.....	.....	.....	0.012	.....	.....	Metallurgical & Chemical Engineering, Vol. 8	1910
Iron—Low Carbon	.....	0.10	0.35	0.031	0.065	0.012	.....	.....	.....	0.034	.....	.....	Metallurgical & Chemical Engineering, Vol. 8	1910
Iron—Melting Bar, Grade No. 1	.....	0.10	.....	{Under 0.012}	{Under 0.012}	.....	.....	.....	.....	.....	.....	.....	Monongahela Iron & Steel Co., Pittsburgh, Pa	1920
Iron—Melting Bar, Grade No. 2	.....	0.20	Low	{Under 0.015}	{Under 0.015}	Low	.....	.....	.....	.....	.....	.....	Monongahela Iron & Steel Co., Pittsburgh, Pa	1920
Iron—Swedish	.....	0.09	0.08	0.011	0.010	0.10	.....	.....	.....	.....	.....	.....	U. S. High Speed Steel & Tool Corp., Green Island, N. Y.	1921
Iron—Wash Metal	.....	3.53	0.07	0.008	0.006	0.10	.....	.....	.....	.....	.....	.....	U. S. High Speed Steel & Tool Corp., Green Island, N. Y.	1921
Manganese—80% Ferro	.....	6.99	80.30	0.020	0.160	0.40	12.13	.....	.....	.....	.....	.....	Blast Furn. Product, Illinois Steel Co., Chicago, Ill	1914
Manganese—80% Ferro	.....	{5.00 to 7.00}	{78.00 to 82.00}	{Under 0.030}	{0.100 to 0.300}	{0.50 to 1.00}	.....	.....	.....	.....	.....	.....	Crocker Bros., New York City	1921
Manganese—80% Ferro	.....	4.72	77.85	.....	.....	1.72	15.80	.....	.....	.....	.....	.....	Southern Manganese Corp., Anniston, Ala	1917
Manganese—80% Ferro	.....	5.92	80.43	.....	.....	2.14	11.10	.....	.....	.....	.....	.....	Southern Manganese Corp., Anniston, Ala	1917
Manganese—Low Carbon Ferro	.....	0.12	93.04	.....	.....	0.39	{About 7.00}	.....	.....	.....	.....	.....	Electro Metallurgical Sales Corp., New York City	1922
	Molybdenum Mo													
Molybdenum Ferro	50.55	0.73	.....	0.190	0.078	0.94	.....	.....	.....	.....	.....	.....	Bureau of Mines, Bulletin 77, Washington, D. C.	1916
Molybdenum Ferro	56.90	1.21	.....	0.220	0.030	0.62	.....	.....	0.08	.....	.....	.....	Climax Molybdenum Co., New York City	1921
	Nickel Ni	C	Mn	S	P	Si	Fe	Al	Cu	O	Co	W		
Nickel 99%, Grade A	99.05	0.10	.....	0.040	.....	0.10	0.47	.....	0.15	.....	0.80	.....	International Nickel Co., Perth Amboy, N. J.	1921
Nickel 96%, Grade D	96.00	0.10	3.00	0.040	.....	0.10	0.47	.....	0.15	.....	0.80	.....	International Nickel Co., Perth Amboy, N. J.	1921
Nickel Ferro	41.50	1.34	.....	0.040	.....	4.33	51.60	0.81	.....	.....	.....	.....	Bureau of Mines, Bulletin 77, Washington, D. C.	1916
Nickel Anodes	96.82	1.70	.....	.....	.....	0.50	0.80	0.03	0.15	.....	.....	.....	Merica-Chemical & Metallurgical Eng., Vol. 24	1921

Do not cut—Fold along this line for binding

(*Continued on Data Sheet No. 533*)

Cut to this point

Note—This sheet may be cut along this line and one half folded over on the other to bind in 5 x 7 inch note book.

THE FOUNDRY DATA SHEET, JULY 1, 1924

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

E. R. WOLVERTON
Vice-Pres. and Gen. Mgr.

ROBERT TINSMAN
President

T. C. WOLVERTON
Secretary and Treasurer

Bloomsbury Graphite Company

Importers and Refiners of

Graphite Products and Foundry Facings

Mills Established 1882

GRAPHITES
SILVER LEAD
PLUMBAGO
BLACKINGS
CORE WASH

PIPE BLACKING
MINERAL FACING
STOVEPLATE FACINGS
CHARCOAL FACINGS
SEA-COAL FACING

Bloomsbury, N. J. June 13th, 1923.

The Foundry,
Cleveland,
Ohio.

Gentlemen:-

The first thing that we did, after deciding our policy to sell Bloomsbury Quality Foundry Facings direct from mills to foundry, was to engage space in The Foundry Magazine, to tell our story to the trade. The fact that we have been continuous advertisers with you ever since is the best evidence of our satisfaction with the results secured.

We feel that this advertising has kept us in close touch with our trade and opened the way for much desirable new business.

When we published our book on "Foundry Blackings", by Dr. Moldenke, we took several pages in The Foundry to announce its helpful purpose.

This was so successful, it ran three editions, every copy being sent out "by request only".

Wishing you continued success, we are

Very truly yours,

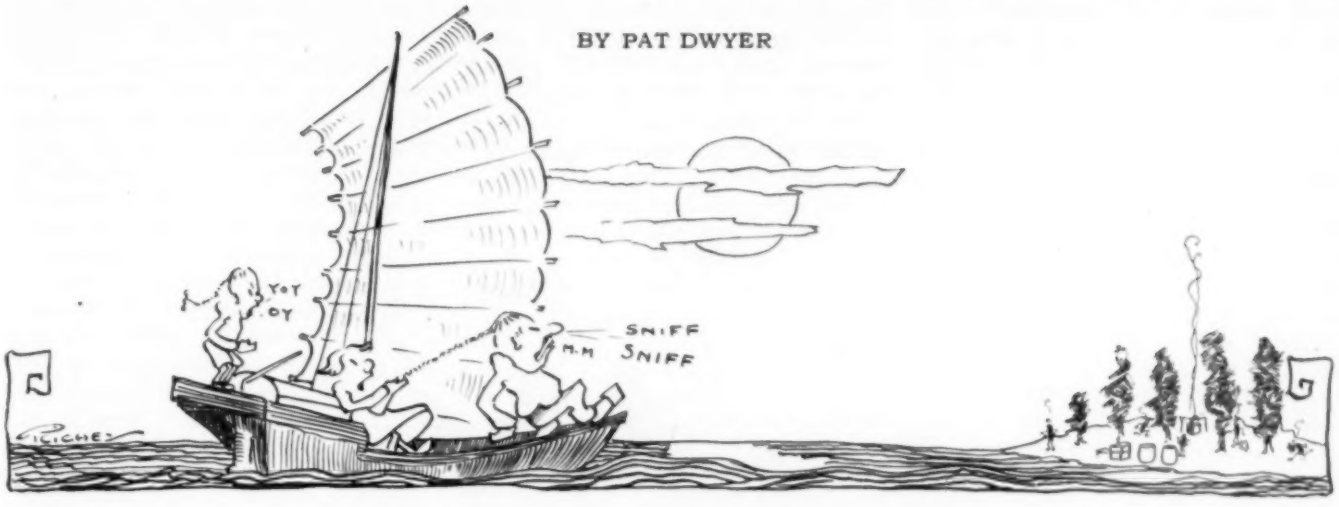
BLOOMSBURY GRAPHITE CO.

By. E. R. Wolverton
General Manager.

E.R.W.W.

Bill on How and Why Molds Are Stacked-I

BY PAT DWYER



AFTER deligent practice extending over a period of many years I have arrived at a state of perfection which enables me to skim through a newspaper in a minimum of time. Considering the pleasure and profit I derive from this morning and evening exercise I am moved to wonder at times if I could not cut out the practice altogether and devote the time to a more useful purpose. The only reason I have for not putting the idea into instant execution is that my motive would be misunderstood. If I had no paper to read at night I probably should sit at ease doing positively nothing, thus affording a certain lady who is related to me intimately, an opportunity to express her favorite opinion concerning people who appear to be constitutionally lazy. She mentions no names, but occasionally I have intercepted a glance in my general direction. Even though I derive neither immediate nor remote benefit from a perusal of the paper, still the fact that I am bestowing a certain amount of attention on it conveys the impression that at least I am not sleeping. Once in a while—a statement that is rather indefinite, but sufficiently accurate in the present instance—I find an item which claims my close attention and I read it carefully all the way through. The information conveyed may be of no direct value, but I derive a certain amount of mental pleasure from the perusal and, therefore, I should be inclined to say off hand that my time is not entirely wasted. Consider, for example, an item that appeared recently describing the arrival in New York of an ancient mariner, his Chinese wife and 10-year-old son who had made the long voyage in a small junk built in Amoy by the ancient one himself.

In all probability I never shall see China and most assuredly if I do journey to far Cathay, I shall select a palatial liner, in preference to a junk, in which to make the voyage. I can't say that my ambition craves long hours, short rations, or the worry incident to holding a course over the trackless wastes of the well known seven seas, but I read with the keenest interest the account of this man and his family who had encountered all these experiences.

The great northern sweep of the Japanese current caught them on their way across the Pacific and by the time they finally crept in among the Aleutian islands tired, hungry, wet and forlorn, their stock of provisions was exhausted, including one perfectly healthy woolly dog which they had taken aboard at Amoy for company. The old captain admitted that the boy missed his playmate for a few days, but then as he philosophically explained, a nice bit of juicy dog on the inside is better than the company of 50 dogs on the hoof, under certain circumstances. Following the curve of the same great circle that carried them so far to the North, the junk and its hardy crew finally arrived at Vancouver and from there proceeded leisurely and in short jumps down the west coast, through the Panama canal and eventually arrived in New York bay.

For all I know to the contrary the story may have had no foundation in fact. It may have had its inception in the imaginative brain of a reporter detailed to cover the activities of the water front, who found more comfort and pleasure in sitting behind a typewriter in a nice cozy office than he did in prowling around the docks at all hours and in all conditions of weather. I have heard of more than one story written in that manner. In fact to be perfectly candid on the subject, the yarns that are spun out of the air usually are more interesting than those based on actual fact and backed up by a mass of actual and tiresomely prosaic detail. This despite the well known saying that truth is stranger than fiction. It may be stranger, but not necessarily more interesting. The first time I met Bill after I had read the story about

QUEER THINGS HAPPEN IN PROHIBITION MAINE

the Chinese junk I asked him if he had seen it—the story, not the junk—and if he had seen it I wondered in what manner it had appealed to him. He admitted that he had seen the item in the paper and was inclined to accept it at its face value, the more so since he had seen other items at various times during the past six months announcing the arrival of the junk at various points on its journey. "I shall not be surprised," said Bill, "to hear later that the old boy has touched at Boston and Bar Harbor and then taken a jaunt up the Bay of Fundy to test out the 60-foot tide and compare it with a similar manifestation in one or two other parts of the world. Afterward he may skirt the coast of Nova Scotia, pay a friendly call at Anticosti and possibly St. Pierre and Miquelon, last possessions of France in North America and then float up to Montreal which has the distinction of being classed as a great ocean port although 1000 miles from the sea. St. Pierre is a source of supply for nearly all the contraband liquor smuggled into the maritime provinces of Canada and there is a possibility that when the ancient mariner sniffs the aroma that hangs over the island like a halo he will decide that his rambling days are over and he may as well spend the remainder of his days there as elsewhere.

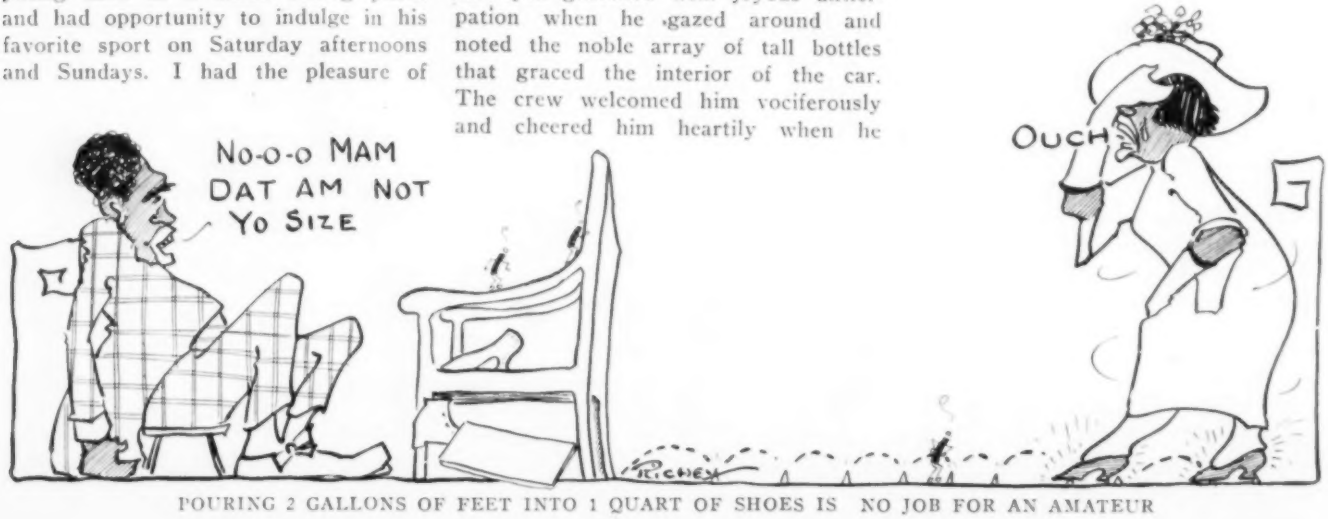
"Last summer I was down in Nova Scotia where I met a friendly young lad who had the happy faculty of spinning yarns purporting to deal with local characters both afloat and ashore. Of course he did not spend all his time in this delightful occupation. He had a joint interest with two other young men in a small racing yacht and had opportunity to indulge in his favorite sport on Saturday afternoons and Sundays. I had the pleasure of accompanying the gang one afternoon and while lying on the low lockers in the cabin one of the members brought up the subject of the international fisherman's race, sailed yearly between representative fishing schooners from both sides of the international boundary line.

"Several years ago when the races were held off Gloucester, a party of maritime province men, including our hero, chartered a special car and with a generous supply of refreshment aboard, refreshment that came in large measure from St. Pierre, and refreshment which I regret to say contributed nothing to the excise duties of His Britannic Majesty's loyal government, they proceeded joyously, and it may be a trifle hilariously, on their way.

"At the international boundary line they were boarded by a duly acredited customs officer of this great prohibition nation, intent on protecting the inhabitants from the demoralizing influence of strong waters. He boarded the train at McAdam Junction and his eyes glistened with joyous anticipation when he gazed around and noted the noble array of tall bottles that graced the interior of the car. The crew welcomed him vociferously and cheered him heartily when he announced his intention of confiscating the entire supply. They regretted exceedingly that in their sublime innocence and ignorance they had unwittingly almost offended Washington in attempting to bring these forbidden goods into a friendly country and they offered to assist him in every way in the faithful discharge of his duties. As an after thought one of the boys suggested that a little round all around would be in order and insisted in the most polite and tactful manner that the agent should join them. He was rather difficult to convince at first, but after he had safely stowed away a particularly fine sample of French brandy where it would do the most good, he became more amenable to persuasion and his protest when a second round was proposed lacked vigor. The third round was accepted as between man and man and after that he shook hands solemnly with every member of the party and declared that when all was said and done, gentlemen, blood was thicker than water. When the gang finally put him off the train at Vanceboro with a long bottle in each hip pocket he was weeping copiously and announcing to the world in general that he was a jolly goo' fella and wouldn't go home 'till morn'.

"The illuminated crowd arrived safely in Gloucester and saw the races. At least a few members witnessed the contest and the other members down to this day do not remember what they saw, if they saw anything. Even the few who followed the contest through their binoculars had great difficulty in understanding why four boats showed in the line of vision, when as they had been led to ex-

NO, ALGERON! YOU ARE MISTAKEN. THE FACE ON THE BAR-ROOM FLOOR WAS BY ANOTHER ARTIST



POURING 2 GALLONS OF FEET INTO 1 QUART OF SHOES IS NO JOB FOR AN AMATEUR

pect, only two were supposed to compete. An overdose of French cognac hailing from St. Pierre has been known to play queer tricks with the optical nerve.

"Several members of the expedition are connected more or less directly with the coal mining industry of Nova Scotia and one night on the way home the conversation turned on famous disasters in that line over a period of many years. One gentleman referred feelingly to the Foord pit explosion in the early '80s where as a result of the explosion the river had broken through its bed and flooded the workings. Fortunately the explosion occurred just after the men of the night shift had been hoisted out of the mine and only about 100 early men and boys of the day shift had been lowered down the shaft. They were all lost. Those who were not killed by the force of the explosion or the resulting poisonous afterdamp, were drowned and although the mine later was pumped out and the majority of the bodies were recovered and given Christian burial; several never have been recovered.

"The narrator dropped to his hands and knees and with a piece of chalk drew a wabbly plan of the mine on the floor of the car. Just as he had drawn a small circle in the center to indicate the position of the shaft, an absent minded member of the party squirted about half a pint of tobacco juice over the drawing. He had aimed at the cuspidor, but had neglected to take into consideration windage, velocity, trajectory and a sudden jolting of the car as the train rounded a curve and as a result the avalanche fell all over the sketch on the floor. The surprised map maker threw a startled glance at the circle of grinning faces. Then he threw up both hands and collapsed with a wild shout, 'My God! The Foord pit is flooded again!' "

"Talking about liquor and the manner in which it makes men see double," said Bill with one of these peculiar mental transitions which enable him to hop from one subject to another for no apparent reason, "I wonder what the first molder thought when he saw the first stacked molds. You know the method practiced in some foundries of stacking small molds on top of one another and pouring the stack as a unit. Basing my opinion on a recollection of some of the old timers, I'll bet you $1.50 he thought he had 'em again and either quit the job or signed the pledge.

"The idea of stacking molds to conserve floor space is not new. Methods adopted by a few men in recent years may be original, but the basic plan itself dates back before my time. In fact, I met an old gentleman the other day who told me he had seen molds stacked on the floor of the foundry where he had served his time many years ago. So far as he could remember, no one claimed even at that time that the method of making molds was either new or revolutionary. Of course, he modestly admitted that the shop in which he had served his time was a trifle ahead of any other in many ways. Stacking molds was accepted as part of the regular daily routine practice and excited no comment. I am willing to admit that old gentlemen's memories sometimes are not as infallible as the owners claim them to be, but that is only a trifling detail and a few years one way or the other does not affect my original statement to the effect that small molds were stacked for pouring at least 50 years ago and probably before that time.

"In the early days the method was confined to molds for castings in which the entire mold cavity was in the drag or lower part of the mold and where the upper face of the proposed casting was perfectly flat. This particular type of casting always is referred to in the foundry as a *flat back*. On a casting of this character and, of course, this also applies to a gate of small castings, it readily is apparent that the body of sand in the second drag serves as a cope for the mold in the first drag. The third drag serves in a similar capacity for the second drag and so on to whatever height is considered safe and convenient.

At present, molds are stacked in five different formations, depending upon local conditions and to some extent the personal choice and experience of the foundryman. Some favor one method, some favor another, while still others in that charmingly frank manner which characterizes the tribe the world over when discussing their own affairs and shop problems, bluntly state that stacking molds is nothing more or less than an invention of the Evil One and, therefore, something to be shunned by any person who values his peace of mind. Also, each is prepared to defend his views in utter disregard of any views put forward by the opposition. So long as the single standard men have room on their floors they intend to continue spreading the molds one tier deep and when they find the available room is not sufficient, they will extend the floor space or install a continuous molding and pouring system by which each mold will occupy floor space only long enough to be poured and shaken out. The space then is utilized for another mold and so on indefinitely. The foregoing explains to some extent and in at least one particular the marked resemblance between a book on foundry practice and an English grammar. Each one is made up of rules 10 per cent and exceptions to these rules 90 per cent."

"I have heard foundrymen accused," I said, "of many things from piracy to thimble rigging, but this is the first time I ever heard of them being associated with such a thing as a grammar. 'Tis a serious charge and if I am not mistaken a charge that will be resented keenly by a free and independent body of men accustomed to expressing themselves in a manner to suit their own convenience and according to the promptings of the spirit. Grammar may have its place, I am not going to commit myself on such a touchy and debatable point, but it certainly cramps one's style."

"Sometimes," said Bill, "you remind me of a saying credited to a sharp tongued member of congress. In the heat of a debate he referred to an honorable gentleman on the opposite side of the house as an ass. The speaker sharply rapped him to order and told him he would have to withdraw the offensive epithet. 'All right,' says our hero. 'All right, I won't say the honorable gentleman is an ass, but I will maintain that if ever he is taken ill he will require the services of a veterinary instead of the services of a man who signs M. D. after his name.' Now if you kindly will slant your long furry ears in this general direction and cease braying for a few minutes I shall describe briefly the various methods in which molds usually are stacked for pouring.

"In the first and most familiar method, the molds are made in a snap flask and usually stacked three or four-high. In some cases the foundryman has found it expedient and convenient to stack them only two-high and in extreme instances it has been possible to stack them as high as 10 at a time. The relative size and weight of the casting and the facilities provided for pouring the iron are the factors which determine the most convenient and economical arrangement. The quality of the sand also must be taken into consideration. With the majority of castings it is necessary to ram the sand harder on the bottom than on the top mold to prevent straining from the static pressure. Unless the sand is sufficiently permeable, the iron will not

lie quietly in the lower mold. The casting will be scabbed and filled with blowholes. This feature has prevented many foundrymen from adopting the process of stacking their molds. They use a fine sand which yields excellent castings when rammed gently in single molds. When rammed to the same density in stacked molds, the lower casting will be strained out of shape. If the sand is rammed hard enough in the bottom mold to resist the strain the casting will be rough and dirty. Instead of discarding the sand and employing a more open grade, the operator usually condemns the method after one or two trials and continues his former practice of pouring his molds in single formation. The method was good enough for his father and grandfather and far be it from him to dishonor their memory.

"Where a proper grade of sand is employed excellent results are obtained and usually the grade of sand and the proper degree of density to which it must be rammed may be determined by a little experimenting. The method may be used with a number of loose patterns or with a set of patterns attached in the usual manner to a plate or board."

"From the manner in which you are fidgeting around," said Bill, "I guess I had better reserve the remainder of what I have to say on this subject until a future occasion. You remind me of the expansive colored lady who meandered into a southern store to purchase a pair of shoes. She had a pair of feet of the general size and appearance of a pair of hams that extended almost equal distances fore and aft. The colored proprietor labored long and assiduously in a vain endeavor to find something that would meet the approval of his dusky customer. Finally he lost all patience at her insistence in trying shoes that even a hydraulic ram could not force on to her feet. 'Woman,' said he, 'the trouble wit' you is you wants to put a pair of two-gallon feet into a pair of half-pint shoes!' "

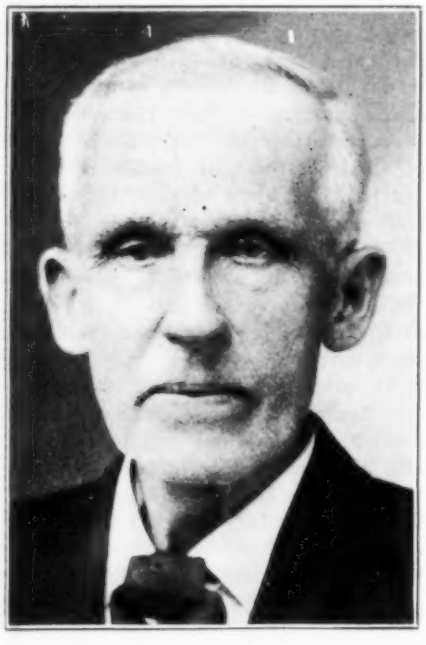
Closes 72 Years of Foundry Service

When John Strickler on June 1 retired from his position as foundry superintendent of Eyster & Weiser, York, Pa., he established a record that has few parallels in the foundry industry. In 1852 at the age of 12 he started to serve an apprenticeship at the trade of molding and at the age of 84 after 72 years continuous service with his original employers and their successors he dropped the bottom for the last time and put away the tools of the trade. He worked as a journeyman molder until 1881 when he was appointed foundry foreman and held that and the superintendent's position for over 40 years.

His career began almost with the inception of the foundry industry in Pennsylvania and he has taken an active part in the evolution of the same industry over a greater period than falls to the lot of the average man. He has seen coke substituted for anthracite coal as a melting medium in the cupola and he has seen the little primitive solid bottom cupola with its pair of small tuyeres, and its 1 or 2-ton charges displaced by the modern drop bottom cupola with its scientifically arranged tuyere system, served by a powerful blower and charged mechanically with more iron in a day than formerly was charged in a month. Rule of thumb methods of charging and grading by fracture have given place to accurately weighed and balanced charges and grading by chemical analysis.

He was one of the first foundrymen in America to realize and appreciate the value of mechanical molding equipment even in its crude state and installed 11 machines in his foundry in 1878. He started to learn the trade in a foundry that employed less than a dozen men and later at times he directed the activities of nearly 300.

Outside the foundry he has taken the part of a public spirited citizen along many lines in his native city. In 1908 he was elected city treasurer and served for one term in that capacity. At the age of 17 he became a journeyman molder and as became a grown up man he promptly joined the volunteer fire brigade and has remained a consistent and enthusiastic member ever since. During his 67 years membership he has served successively as pipe man, chief hose director, foreman and president. He has been a member of the board of trustees continuously since its formation in 1886. For the past four years he has been president emeritus. In 1859 he joined Capt. Hay's Worth Infantry and saw active service with the Union forces for a period of three months in 1861. At present he is one of the three surviving members of the organization.



JOHN STRICKLER

He began his foundry career at a weekly wage of $1 with the firm of Slaymaker & Durkee. In 1878 the firm was absorbed by George Baugher who operated a foundry on Market Street. In 1881 a new plant was erected on the present site at the Philadelphia Street bridge and Mr. Strickler was appointed foreman. In 1894 Eyster & Weiser succeeded as owners of the foundry and they in turn have been followed by their sons, Frank Eyster and George U. Weiser, the present owners. Mr. Strickler married Amelia Stair May 15, 1873. She died recently, a few days before their 50th wedding anniversary.

Opens Branch Office

D. R. Schively has been made manager of the office recently established at 1576 Union Trust building, Cleveland, by the P. H. & F. M. Roots Co., Connersville, Ind.

Plan Electric Foundry

National Electric Steel Castings Co., Cleveland, recently was incorporated with $100,000 capital stock to operate a foundry. John C. Barkley and John P. Sturges, of Frank P. Quail, National City building, attorney, are representing the principals in the transactions. A plant is to be leased and operations begun soon.

The name of the Mathews Gravity Carrier Co., Elwood City, Pa., has been changed to the Mathews Conveyor Co.

Fig. 1—Molding Benches Are Placed Back to Back Down the Center of the Foundry—Aisles, 10 Feet Wide, Are Paved With Iron Plates

Malleable Plant Placed in Service

BY E. C. BOEHRINGER
Chicago Editorial Representative

COREROOM light, airy and clean enough to be a candy factory; molding floors with benches removed from drafty windows and sand-drying heat; hard and soft iron tumbling mills mounted upon platforms to wrest a maximum of utility from cranes and gravity; a continuous annealing oven 347 feet long; ventilation and lighting so adapted that neither shadows nor enervating gases or heat are encountered—these features characterize the new plant of the Belle City Malleable Iron Co., Racine, Wis.

Unusual difficulties confronted the owners and engineers when this foundry first was projected. One problem was to dismantle a plant spread over two city blocks and construct new units, laid out and equipped to promote the economical production of quality castings, having double the capacity of the old

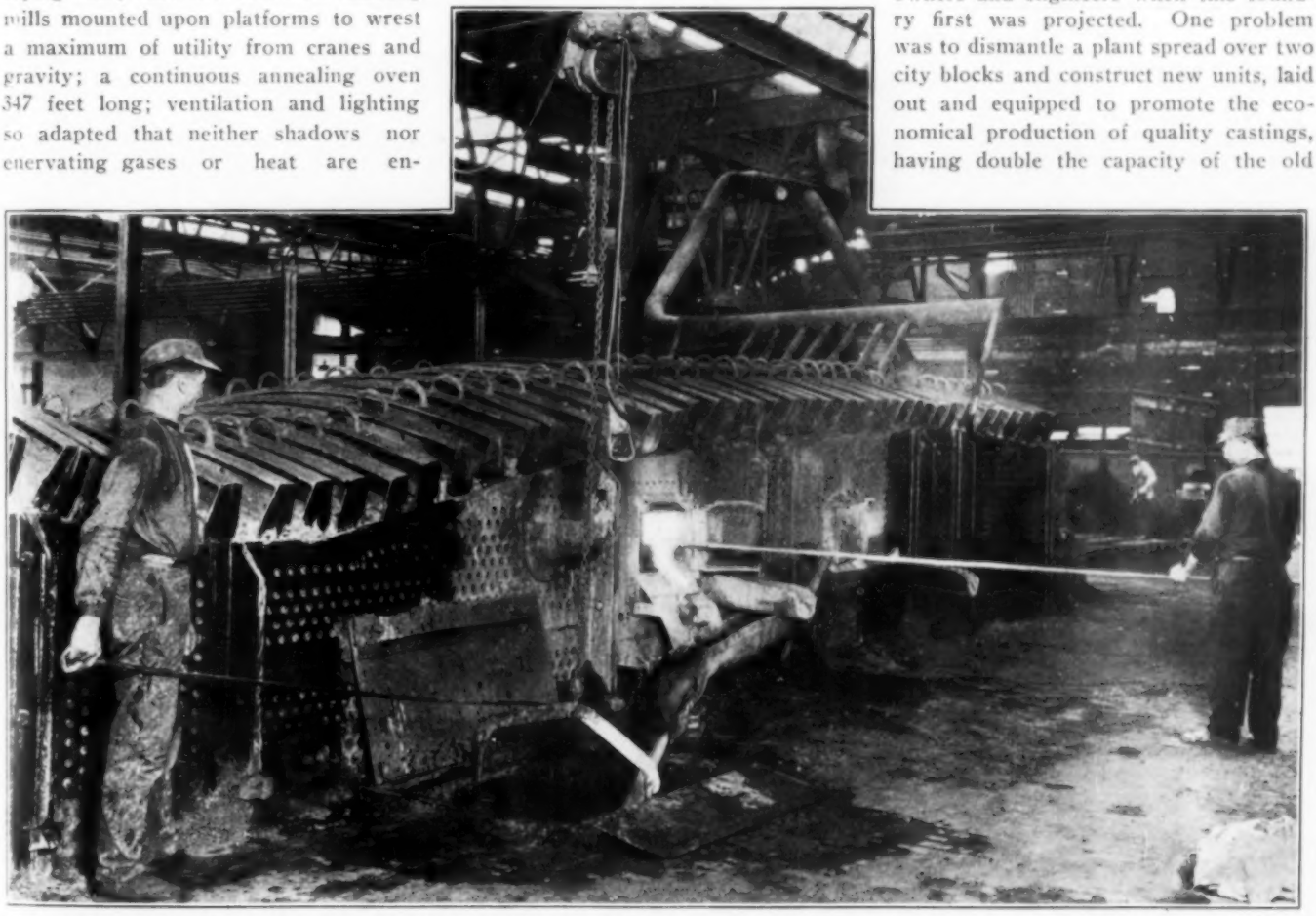


FIG. 2—SLAG FLOWS FROM THE FURNACE SPOUT INTO A CROSS TROUGH WHERE A 2½-INCH STREAM OF WATER WASHES IT INTO A PERFORATED BUCKET IN THE FLOOR—THE DETAILED PLAN IS SHOWN IN FIG. 6

plant, without complete cessation of operations during the construction period.

The rebuilding program has been under way since January, 1923, and the plant now is complete except for two air furnaces, one-half of the molding floors, the power house and the material yard. By the end of this year it is expected the proposed ultimate capacity—20,000 tons of malleable castings annually—will be available for operation.

lishment is there found a room so light and spacious as the coreroom of the Belle City plant. A flood of light pours in through the monitor-type roof. On two sides of the room are windows. Directly in front of the double-ended ovens and dropping from the roof to within 8 feet of the floor is an ⅛-inch asbestos board partition, sprayed a spotless white. This reflects the light flooding in from the roof and gives the effect

arated by 4-foot aisles, which permit the boxes to be filled from the back of the benches without disturbance to the core makers. Cores are deposited upon portable racks, 4 x 5 feet and 6 feet high, which are taken away by jack lift trucks.

Two steel elevating towers with a revolving screen, a hopper and a sand mixer between them prepare the core sand. Sand is shoveled into the hopper

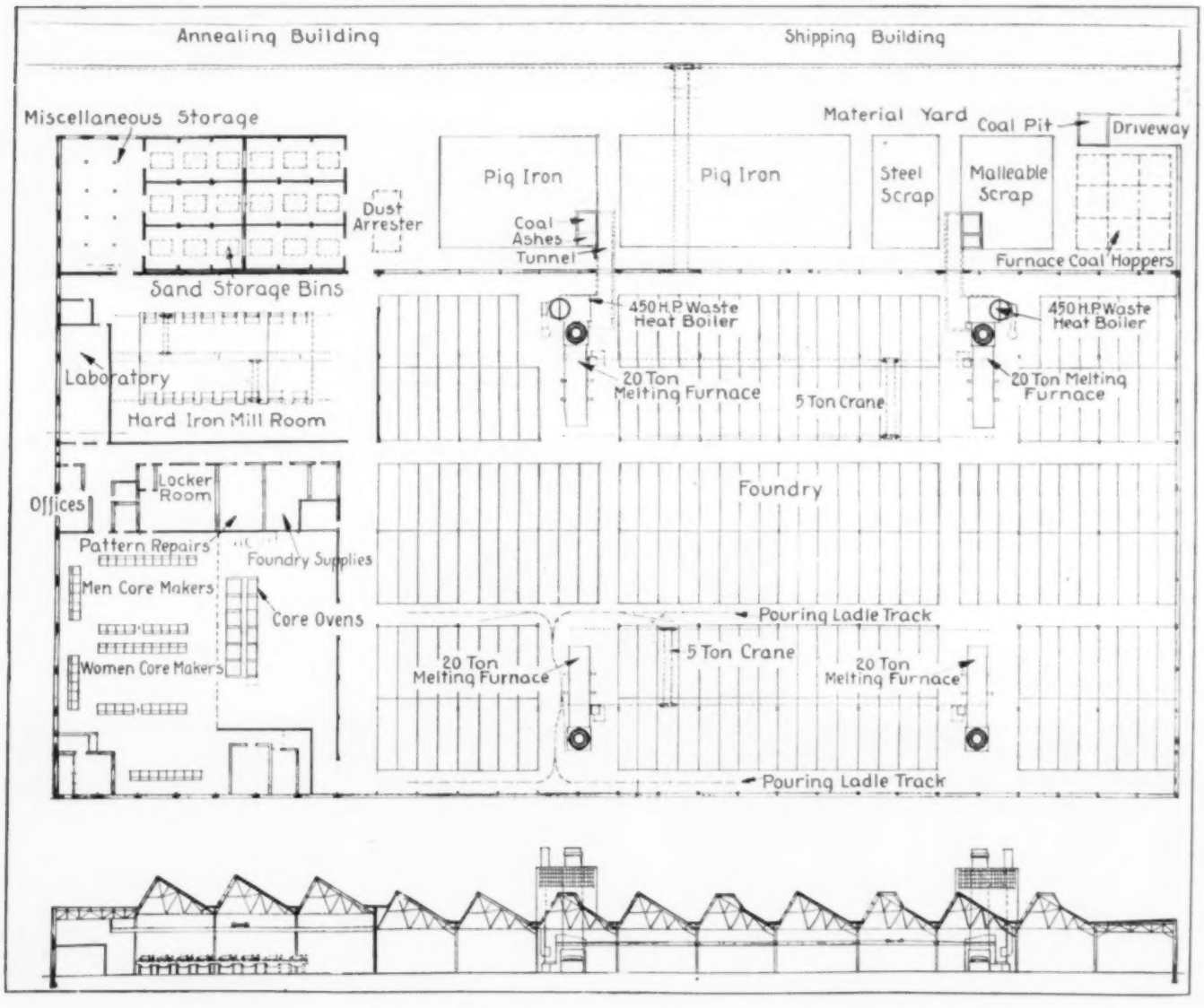


FIG. 3—ARRANGEMENT OF FURNACES, WIDE AISLES AND ADEQUATE HANDLING EQUIPMENT ASSIST IN THE DISTRIBUTION OF IRON

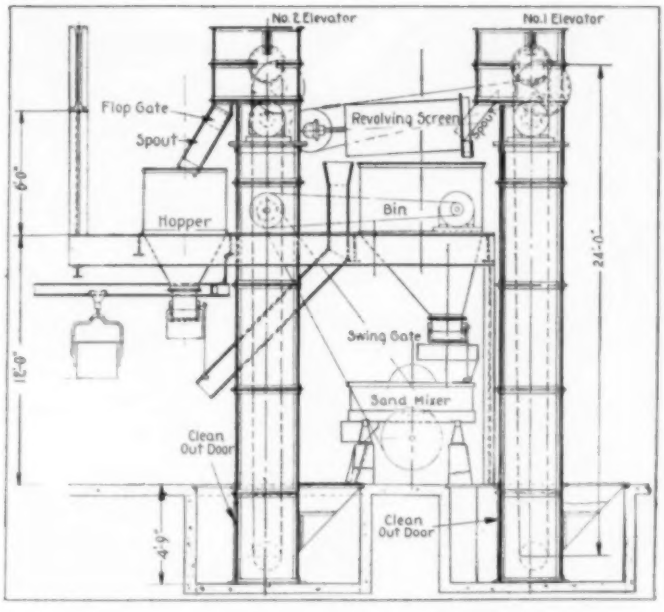
The products of the Belle City company cover the range of malleable iron castings and normally run one-third each of automobile, railroad, and farm implement and tractor parts. The assertion of the Belle City company and the engineers, A. A. Wickland & Co., Inc., Chicago, that the new plant embodies the most advanced development in malleable practice is one with which visiting foundrymen—and there have been many—do not differ.

Rarely in any manufacturing estab-

of outside light. Effective as a light source, this partition is of even greater value in acting as a barrier to the heat and gases from the ovens.

In the coreroom as well as in the foundry, the benches, 60 of which are in use, are removed from the windows, thus overcoming the discomfort arising from drafts and proximity to heating coils. The benches are steel, with wood tops, and with the sand boxes in front of the core makers. Where the benches are placed in double rows, they are sep-

of one elevator, which hoists it and drops it into the revolving screen. Through the meshes of the screen the sand drops into a steel bin, is tempered and deposited in the mixer. Again it is elevated and discharged into twin hoppers, from which it is handled to the boxes on the core makers benches. This arrangement permits enough sand for a day's requirements to be prepared in two hours. In addition to the 60 benches, the coreroom equipment includes one core machine and two roll-over ma-



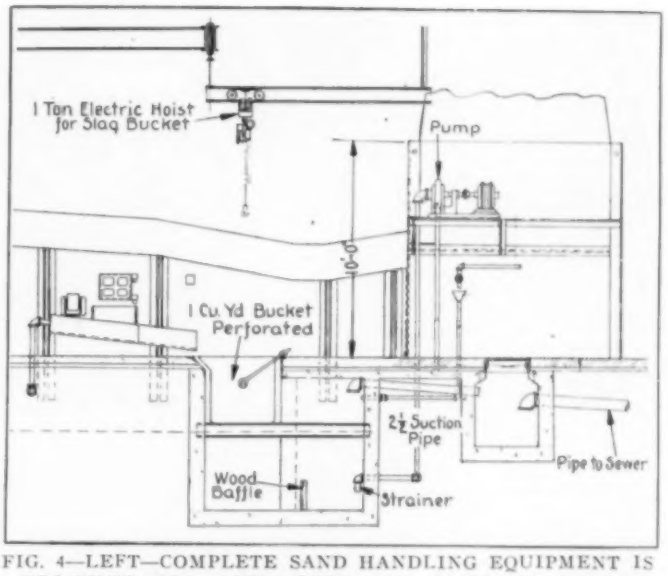


FIG. 4—LEFT—COMPLETE SAND HANDLING EQUIPMENT IS PROVIDED FOR BOTH CORE AND MOLDING SAND—FIG. 6—DETAIL OF SLAG HANDLING SYSTEM

chines. Core driers are stored on special racks above the locker, rest and toilet rooms that have been provided for the women core makers.

Six brick, double-ended ovens whose inside dimensions are 6 x 14 feet, 7 feet high provided ample capacity for baking the cores. The double-ended design moves the work in a straight line and the oven gases and heat escape nearly 20 feet back from the asbestos board partition. The ovens are fired individually with gas, with the firing pits below the floor level, making possible a flush floor without gratings. A stairway is provided at both ends of the battery for egress in case of accident. Provision has been made for the use of fuel oil instead of gas when conditions warrant.

At this time only half of the foundry proper and two of the air furnaces have been installed, but eventually the foundry will be 230 x 378 feet, with 200 molding floors each 9 x 32 feet, and four air furnaces of 20 tons capacity each. The two furnaces not yet installed will each be equipped with 450 horsepower waste heat boilers which will furnish the steam.

The greatest distance from any furnace to any molding floor will be 90 feet. There will be four 10-foot aisles, two of them along the outside walls. These aisles are provided to afford free approach for the sand cutters, relieve congestion, shorten the distance iron must be carried and give greater all-around freedom, especially in trucking out castings. Cast iron plates form the aisle floors and expedite the movement of sand cutters and trucks.

The molders' benches back up against

FIG. 5—CORE SAND IS ELEVATED AND DROPPED INTO A REVOLVING SCREEN, THROUGH WHICH IT TRAVELS TO A BIN OVER THE MIXING PAN INTO WHICH ANY REQUIRED AMOUNT MAY BE DROPPED—FIG. 7—FROM THE MIXING PAN IT IS ELEVATED AND DROPPED INTO MOVABLE BINS FOR DELIVERY

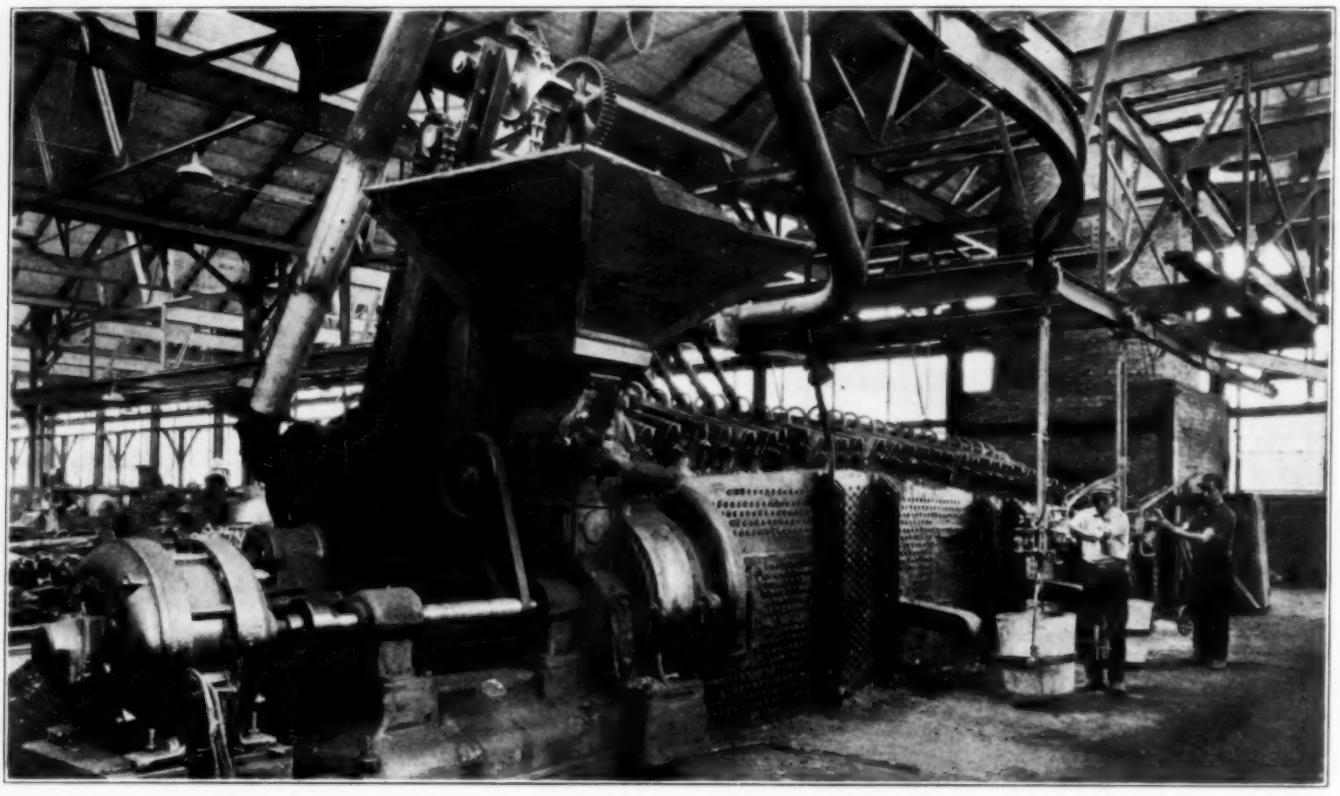


FIG. 8—PULVERIZING EQUIPMENT IS INSTALLED AT THE FURNACE AND COAL IS POWDERED AND DELIVERED DIRECTLY TO THE BURNERS—PERFORATED IRON SIDE PLATES ARE USED—METAL IS TAPPED INTO LADLES SUSPENDED FROM MONORAIL CARRIERS

each other and are separated by a 5-foot partition. Above this partition are tracks upon which a moveable shield is hung. This shield is moved with the sand cutters and serves as a backstop to prevent sand being thrown over the partition upon the opposite floor. Concrete runners 24 inches wide form the dividing lines between floors and the sand cutters are run in upon these. The intervening space for the molders' floors is clay. Castings are poured and shaken out on the floors. Ninety per cent of the 200 floors will be equipped with air squeezers. The heavy work is molded in the center bay under a crane.

The sawtooth roof of the foundry has an extraordinary capacity to admit light and exhaust gases. Instead of being vertical, the face of the sawtooth is at an angle of 30 degrees and comprises one row of top hung, one row of bottom hung and one stationary row of sash. Every alternate sawtooth is provided with one row of top hung sash directly opposite the upper top hung sash of the face. This permits an unobstructed sweep of air through the apex of the saw tooth. Steam and gases are dissipated immediately even on the coldest winter day, and at Racine the thermometer frequently threatens to drop through the bottom. The roof trusses

FIG. 9—HARD IRON CASTINGS ARE DELIVERED TO THE TUMBLERS BY WOOD-LINED, CRANE-CARRIED, DUMP BOXES—EIGHT MILLS DISCHARGE INTO TRUCKS ON THE LOWER FLOOR LEVEL—TWO MEN HANDLE THE ENTIRE BATTERY

are 18 feet above the floor, with columns spaced 36 feet apart. The sidewalls have 10 feet 6 inches of continuous sash and one row of top hung sash, making 15 feet of glass area above the sill, which is 6 feet above grade.

Except that two of the air furnaces will have waste heat boilers as auxiliaries, the four furnaces will be identical. They measure 45 feet long x 9 feet 6 inches wide, outside dimensions. The use of pulverized coal permits the removal of the front bridge wall and the length between bridge walls accordingly is 29 feet; with hand firing this distance would be only 21 feet. The inside width is 6 feet 6 inches. The brick stacks are 55 feet from base to top, with the lining from 9 to 13½ inches and the inside diameter 4 feet. Blower pressure is 3½ ounces. The sidewall plates of the furnaces are perforated to prevent cracking.

The furnaces are set in pairs with 16 double floors between them and a runway for a 3-ton crane over these floors. These cranes lift the bungs, charge the furnaces and transport iron to the floors they pass over. Special charging buckets holding up to 5 tons are filled and weighed in the material yard and trucked to within reach of the crane. These buckets are of ⅜-inch steel plate, 4 feet 6 inches x 4 feet x 3 feet high. A bail with a catch is affixed so that when they are placed over the furnace a movement of the catch causes the bucket to rotate on its trunnions and discharge its load without damage to the lining of the furnace. A monorail system with trolleys and ladles holding 800 pounds of metal is being installed at present to handle iron to the floors of the foundry.

FIG. 10—GENERAL ARRANGEMENT OF COREROOM—NOTE CONVENIENCE OF THE TOP FILL, BOTTOM DELIVERY SAND BOXES

Manufacturers of Equipment

AIR COMPRESSORS
Chicago Pneumatic Tool Co., New York.

ANNEALING OVEN
American Dressler Tunnel Kilns, Inc., Cleveland.

CORE OVENS
Foundry Equipment Co., Cleveland.

CORE MACHINE
William Demmler & Bros., Kewanee, Ill.
International Molding Machine Co., Chicago.

CORE RACKS
Foundry Equipment Co., Cleveland.

CRANES
Milwaukee Electric Crane & Mfg. Co., Milwaukee.
Modern Pouring Device Co., Port Washington, Wis.
Motorbloc Corp., Philadelphia.

DUST ARRESTERS
W. W. Sly Mfg. Co., Cleveland.

ELEVATORS FOR SAND MIXER
R. W. McIlvane Co., Chicago.

EXHAUSTERS
Garden City Foundry Co., Niles, Mich.

GRINDERS
Safety Emery Wheel Co., Springfield, O.
Ransom Mfg. Co., Oshkosh, Wis.

HEATING SYSTEM
Almirall & Co., Chicago.

IRON MILLS
W. W. Sly Mfg. Co., Cleveland.

LIFT TRUCKS
Lewis-Shepard Co., Boston.

OVEN BLOWER
Spencer Turbine Co., Hartford, Conn.

POWER SQUEEZERS
Federal Malleable Iron Co., West Allis, Wis.
Milwaukee Molding Machine Co., Milwaukee.
Wm. H. Nichols Co., Inc., New York.

RECORDING PYROMETERS
Brown Instrument Co., Philadelphia

SAND BLAST EQUIPMENT
W. W. Sly Mfg. Co., Cleveland.
American Foundry & Equipment Co., New York.
Rockford Malleable Iron Co., Rockford, Ill.

SAND MIXER
National Engineering Co., Chicago.

SAND CUTTERS
American Foundry & Equipment Co., New York.

SLAG CIRCULATING WATER PUMP
Chicago Pump Co., Chicago.

STEEL WORK
Kenwood Bridge Co., Chicago.

The experience of the Belle City Malleable Iron Co. with pulverized coal has shown that the cost of operating the pulverizer is less than 25 cents per ton of iron melted. At the firing end of the furnace, screenings are elevated to a hopper which drops them into the pulverizer, which is direct connected to a 35-horsepower motor. The screenings are ground to 60-150 mesh, picked up by a fan and delivered through a 10-inch pipe to a centrifugal fuel mixer. The secondary air is admitted through the center and mixes with the fuel at the tip of the burner. This insures an even mixture, reduces the velocity, retards the flow of the fuel mixture and results in complete combustion with a melting ratio of 3 to 1 or better. The high temperature zone is near the front of the furnace above the hearth.

Another outstanding feature of economy is the recovery of iron flowing off with the slag, by chilling of the slag immediately on its leaving the slag spout. A concrete pit 7 feet 6 inches x 5 feet x 7 feet deep has been built into the floor.

FIG. 11—CHARGING END OF THE CONTINUOUS TUNNEL TYPE ANNEALING KILN SHOWING ENTRY OF A CAR

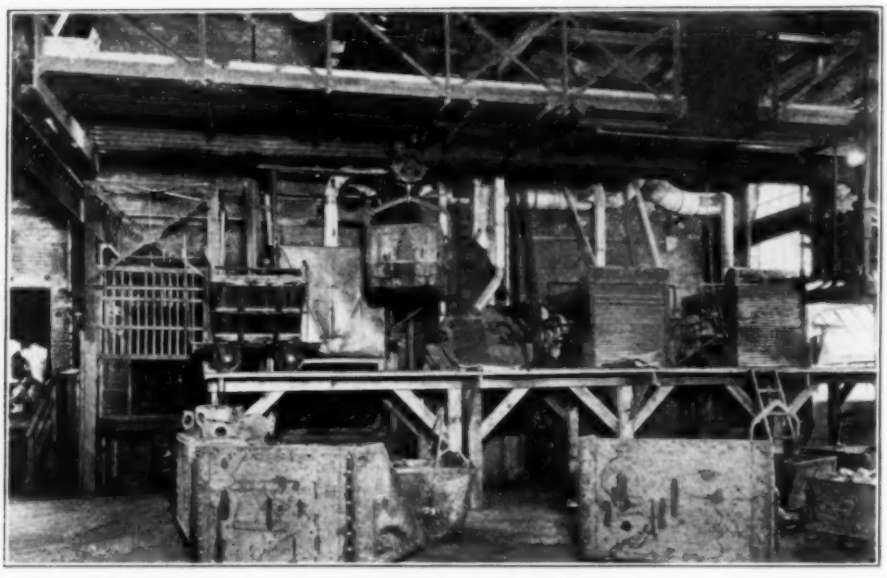


FIG. 12—SAND BLAST EQUIPMENT IS PLACED SO THAT WORK MAY BE CHARGED AND DELIVERED READILY

This is filled with water to within 1 foot of the level of the floor. Into this pit, with its top flush with the floor, is set a steel bucket of 1 cubic yard capacity, its sides perforated. A steel trough leads 6 feet from the slag spout to the bucket. A 2½ inch stream of water enters the trough just above the spout and washes the slag into the bucket. The water crumbles the slag, releases the iron and makes its recovery easy by the use of a magnet. When filled, the bucket is hoisted by an electric hoist and its contents dumped into a truck and carried to the material yard. The water used in this operation is circulated by a single-stage centrifugal pump driven by a direct-connected 2-horsepower motor, having a capacity of 100 gallons per minute, and mounted upon a platform beside the stack. After washing the slag into the bucket the water escapes through the perforated sides and is drawn out of the pit through a screen.

By attaching the waste heat boilers to the two furnaces nearest the material yard a convenient arrangement of fuel entry and ash withdrawal is made possible. Firing pits for the boilers will be directly below them, with a width of 10 feet, a length of 14 feet and headroom of 8 feet. Connecting this pit with the material yard outside will be a tunnel 28 feet x 6 feet x 8 feet high and with the floor 9 feet below grade. At the yard entrance to this tunnel will be a well for both ashes and coal. Thus no trucking of coal or ashes over the main foundry floor will be required and the firemen will be entirely off the floor.

Labor cost is reduced and economy is effected in the handling of castings before and after milling by mounting the hard iron tumbling mills upon a platform 5 feet 9 inches above the mill room floor. The mill room is 74 x 120 feet with a wood block floor. The platform is steel, 40 x 58 feet, with a 3-inch wooden deck carrying eight tumblers. Eventually, the platform will be lengthened 11 feet and four more mills erected. After the shakeout, castings are loaded into steel buckets on the molding floors and hauled by a tractor to the mill room, where the buckets are picked up by 2-ton cranes having wheels of the unusual diameter of 20 inches. The cranes handle the covers and load the mills. All exhaust pipes, motors and line shafts are below the platforms and only two men are now required to operate the mills. Beneath each mill is an open chute, made of steel with a wood lining, inclined 30 degrees. Trailer trucks are spotted under the chutes and when filled are made up into trains for the trip to the annealing department. The mild angle and the wooden lining of the chutes prevent breakage. Eventually a 5-ton monorail, system will handle castings and all material.

The annealing building is brick, with steel trusses, gypsum roof, concrete floor, 77 x 500 feet. A tunnel kiln or continuous annealing oven is in operation in this building. Through this oven which is 347 feet long, truck loads of castings pass continuously. The oven has a capacity of 60 tons of malleable castings every 24 hours. The castings are delivered to this department from the hard iron room and chipped, sorted and packed into annealing pots. The pots then are loaded with a 5-ton crane onto the annealing cars which are spotted on a track parallel to the continuous annealing oven. The cars are pushed into the receiving end of the oven by a gas tractor and are advanced periodically by a hydraulic ram. The cars are allowed to stand on the return track until the castings have cooled sufficiently, after which the pots are picked up by the crane and dumped into buckets. The buckets are conveyed by crane to the soft iron mills and the sand blast mills. Four annealing ovens of the old type have been saved from the old annealing department for reserve.

One tilt mill and three sand blast barrels comprise the present sand-blast equipment. Like the hard iron mills, the 12 soft iron mills are mounted upon a platform 5 feet 9 inches above the floor and in similar manner are served by a crane in loading and by gravity in discharging the castings to waiting trucks. The soft iron mill platform is 13 feet 7 inches x 111 feet, with a 3-inch wooden deck covering. The sand blast

(*Continued on Page* 533)

FIG. 13—A COMPLETELY EQUIPPED LABORATORY IS PROVIDED FOR CHECKING MATERIALS USED, METAL ANALYSES AND FOR TESTING THE PRODUCT

I. B. F. Meets at Newcastle

Program of Twenty-first Annual Convention Includes Papers from United States, France, and Holland—Practical and Scientific Subjects Discussed—Officers Elected

COMING of age this year, the Institute of British Foundrymen held its twenty-first annual convention at Newcastle-on-Tyne, June 4-6. From the time it was opened by the senior officials of the city, the Chamber of Commerce, and Durham university, until it closed with an excursion down the historic river where stone ramparts against the marauding Scot have given place to modern shipbuilding plants which English and Scotch genius have combined to rear, the meeting was replete with interest of both a technical and social character. This was partly the result of the fact that the 1924 convention was one of the most largely attended gatherings in the history of the organized efforts of British foundrymen. The program of entertainment and plant visitation arranged by the Newcastle reception committee was the most comprehensive and elaborate since the war, while the papers read at the technical sessions covered a wide range of foundry problems. The annual dinner, Wednesday evening, June 4, was undoubtedly the most brilliant since the organization of the Institute nearly 21 years ago. A large number of the industrial and civic leaders of the east coast of Britain attended, together with prominent representatives from all other parts of the country, and from the United States and the continent of Europe.

The close bond which exists between the American and British foundry industries was again emphasized at Newcastle. A cablegram of fraternal greeting from President G. H. Clamer was read at the opening session. The American Foundrymen's association was officially represented by its past president, H. D. Miles, Buffalo Foundry & Machine Co., Buffalo, N. Y. The annual A. F. A. exchange paper was received with acclaim and it was pointed out that this arrangement, which was initiated by the A. F. A. and I. B. F., is now in its fourth year. Never before has such definite provision been made for the exchange of practical engineering information between two countries. A paper also was presented at the Newcastle convention on behalf of the French Foundrymen's association. Telegraphic greetings were received from the Italian Foundrymen's association. The Dutch organization of foundrymen was represented by Count A. E. Boddaert, Middleburg, Holland, and A. Van Aarst, foundry proprietor, Weert, Holland.

The New Officers

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Smith Patterson & Co., Ltd.
Blaydon-on-Tyne

Senior Vice President
J. CAMERON
Cameron & Roberton, Ltd.
Kirkintilloch, Scotland

Junior Vice President
VINCENT C. FAULKNER
Foundry Trade Journal
London

Honorary Treasurer
F. W. FINCH
Gloucester

General Secretary
WILLIAM G. HOLLINWORTH
38 Victoria street
London

Members of Council
(Elected 1924)

A. R. BARTLETT, LONDON; WESLEY LAMBERT, LONDON; H. PEMBERTON, DERBY; G. E. ROBERTS, COVENTRY; JOHN SHAW, SHEFFIELD.

The opening session of the convention was called to order Wednesday morning, June 4, by the retiring president, Oliver Stubbs of Manchester. Addresses of welcome were delivered by Dr. R. W. Simpson, deputy Lord mayor; Lord Joicey, president of the Newcastle Chamber of Commerce, and Sir Theodore Morison, principal of Armstrong college, University of Durham.

Shaw Receives Medal

Following the opening ceremonies, the Oliver Stubbs gold medal, which is awarded annually for distinctive service to the British foundry industry, was presented to John Shaw, foundry manager, Brightside Foundry & Engineering Co., Ltd., Sheffield. Mr. Shaw is one of the founders of the Institute of British Foundrymen. He is its representative on the international committee which is studying the question of uniform tests for cast iron.

An illuminated address was presented to H. L. Reason, as a testimonial to his services as president during his year of office, 1922-3.

Just before he retired from the chair, Oliver Stubbs, who has twice been president since 1920, was unanimously elected a special honorary member for life.

The results of the election of officers for the ensuing year, 1924-5, as shown in the accompanying box, having been announced, R. O. Patterson, managing director, Smith Patterson & Co., Ltd., Blaydon-on-Tyne, was conducted to the chair. In his presidential address, which will be published in an early issue, Mr. Patterson pointed out the necessity for commercial research in order to broaden the markets for castings and traced comprehensively some of the recent technical achievements of British foundrymen.

In the report of the council it is stated that the I. B. F. now has 1556 members, the Lancashire branch being the largest with 279.

The first paper on the program was read by L. Northcott, University of Birmingham, dealt with the formation of graphite in cast iron. The paper embodies the results of laboratory experiments on specimens of both gray and malleable iron. In the absence of the authors the annual exchange paper of the American Foundrymen's association—Production of Castings in Permanent Molds—was read in abstract by H. Cole Estep. A paper describing continental European cupola practice was read by A. Van Aarst.

At the second session which took place Thursday morning, June 5, H. D. Miles, past president A. F. A., read the text of the illuminated address which is being prepared for the Institute of British Foundrymen in appreciation of the welcome which the American delegation received while it was in England last year. Mr. Miles also described the exhibition of foundry equipment and supplies which is held in conjunction with the annual meetings of the American Foundrymen's association and emphasized its great practical and technical value.

In a brief address Oliver Stubbs, past president, referred to the appreciation of British foundrymen of the work which has been done in the past four years by H. Cole Estep as chairman of the committee on international relations of the A. F. A., and expressed the regret of the Institute of British Foundrymen on learning that Mr. Estep intends to return to the United States. These re-

marks were seconded by Col. W. F. Cheesewright, publisher, *The Iron & Coal Trades Review*, London.

The technical sessions were then continued with the reading of a paper by A. E. Logan, R. & W. Hawthorne, Leslie & Co., Ltd., Newcastle, on Nonferrous Alloys in Marine Engineering, With Special Reference to Admiralty Gunmetal, Manganese Brass, and White Metals. The paper was illustrated by lantern slides.

A paper dealing with the thermal analysis of cast iron from the standpoint of pure science, with notes on its practical application, was read on behalf of the Association Technique de Fonderie de France by Pierre Chevenard, professor of metallurgy at the St. Etienne School of Mines. This paper was illustrated by lantern slides.

The technical sessions were concluded with an extremely practical and interesting paper entitled "The Technical Side of Oil-Sand Cores," by C. W. H. Holmes, Birtley Iron Co., Birtley.

Entertainment Functions

The arrangements of the Newcastle reception committee for the entertainment of the visitors were unusually complete. In addition to the annual banquet already alluded to, a luncheon was given on Friday, June 6. The guests were tendered a civic welcome by the Lord Mayor of Newcastle, Stephen Easten, at Jesmond Dene on Thursday afternoon, June 5. A theater party was held the same evening. On Friday the arrangements were concluded with an automobile drive to Rothbury and a sail down the Tyne on the steamer SIR WILLIAM STEPHENSON. The ladies were specially entertained with an automobile drive to Whitley bay and a luncheon at which they were welcomed by the Lady Mayoress.

Among the numerous plants in the vicinity of Newcastle which were visited by parties of foundrymen during the convention were: Wallsend Slipway & Engineering Co.; C. A. Parsons & Co., Ltd.; Northeastern Marine Engineering Co., Ltd.; Smith-Patterson & Co., Ltd.; Sir W. G. Armstrong, Whitworth & Co., Ltd.; and C. T. Maling & Sons.

The Newcastle local committee, which was accorded a special vote of thanks for its highly successful arrangements, was headed by E. Wood, chairman, and H. J. Young, vice chairman. Colin Gresty, as general honorary secretary, had charge of the details of the program. H. F. Parsons acted as treasurer. The other members of the committee included: F. Adam, J. A. Campbell, J. W. Frier, M. E. Gallon, W. P. Gospel, M. B. Herbst, H. C. Jay, W. Mathews, T. McPherson, W. J. Paulin, H. A. Rang, F. Sanderson, Edward Smith, James Smith, Robert H. Smith, Victor Stobie, A. H. Tait, George Vardy, J. M. Weir, Miss M. D. Pittuck, and R. O. Patterson.

Making Large Castings

Large castings for the Canadian General Electric Co. Toronto, Ont., are being finished at the Peninsula plant of the Wheeling Mold & Foundry Co., Wheeling, W. Va. Among them are segments for a mammonth fly-wheel which when complete will be 30 feet in diameter. It is cast in two parts and each segment weighs approximately 70,000 pounds. It will be necessary to have a specially constructed car to handle it for under ordinary circumstances the height would be such as to prevent it going under overhead bridges and through tunnels.

A number of extra large gears to be be used in sugar mills in Cuba are being completed for the Hooven, Owen & Renschler Co. They are 10 in number and each will weigh about 20,000 pounds. Each segment is 13.4 feet in diameter and about 18 inches across the face. These are cast and machined in one piece.

Purchases Business

The Gisholt Machine Co., Madison, Wis., has purchased the business including the stock of finished machines, parts in process, patterns, drawings, jigs, tools, fixtures, etc., of the Millholland Machine Co. Indianapolis, and will continue to manufacture the machines at Madison which formerly were made by the Millholland company.

Takes Over Plant

H. S. Cook & Co. has taken over the plant of the New Burrell-Johnson Iron Co., Yarmouth, Nova Scotia. The company will manufacture a line of ranges, cook stoves and heating stoves. The promoters of the company are Howard S. Cook, Charles Purdy and Alex. Ross, all of whom have been connected with the Burrell-Johnson Co.

To Sell Plant

The plant and equipment of the Troy Foundry & Machine Co., Inc., Troy, N. Y. will be offered for sale at public auction at the plant on July 25. Frank H. Deal and Ralph H. Sleicher are receivers in charge of the sale.

Max Riebenack, Lansdowne, Pa., is connected with the Philadephia branch of the Industrial Works, Bay City, Mich. Mr. Riebenack formerly was mechanical and research engineer with the National Aniline Chemical Co., and the Industrial Separators Co., Philadelphia.

Contraction Allowance On Piston Corebox

Question—We employ baked cores altogether in the manufacture of automobile piston castings and we find that where manufacturers work the casting down to 1/16 or 3/64-inch walls an apparent swelling in the core causes the tool to cut through. This trouble only appears in the case of cores made from coreboxes finished according to shrinkage measurements both up and down and across. Where we have employed a standard rule for diametral measurement and a shrink rule for measurement of length the cores have given no trouble and we are wondering whether other foundries engaged in the same line have had similar experience.

Answer—Theoretically iron contracts ⅛-inch to the foot from the time it solidifies until it is cold enough to handle. The terms shrinkage and contraction are used somewhat loosely around the foundry as if they were synonomous terms when in reality they refer to two distinctive stages in the same process. Shrinkage specifically refers to metal so long as it remains in a molten condition, or from the time it is poured until it has set. Contraction is the term applied to the change which takes place in the outside dimensions of the casting during the period elapsing between the time it sets until it has arrived at atmospheric temperature. Under unrestricted conditions as iron casting will contract approximately ⅛-inch to the foot; but where resistance is offered, either by hard dry sand cores, or, by some peculiarity in the shape of the casting, the amount of contraction will be reduced materially and in extreme instances some of the casting dimensions will equal those of the pattern. The patternmaker is guided by experience in determining just how much constraction allowance is required in any given instance. Thus, in making a corebox for an automobile engine piston he will regulate his measurements according to whether the casting is to be made with a dry-sand or a green-sand core. If a green-sand core is to be employed he will provide the usual diametral contraction allowance because the green sand will offer no resistance. In the event that a dry sand core is to be used he will provide no contraction allowance because he knows that the hard dry sand core will not yield and that the interior diameter of the casting will be the same as the exterior diameter of the core.

Milestones in Foundry Progress

As Recorded in the July Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

This is the first of a series of reviews of the serious and frivolous facts in foundry history. If these items bring to your memory unrecorded facts of interest, write and tell us about them.—The Editors.

1894

"MOLDERS are not hot house plants by any means, yet they ought to have by far more comfortable quarters to work in than are at present allotted to them," said Henry Hansen, then editor of THE FOUNDRY, in commenting on the need for better lighting, heating and ventilation. His wish was prophetic, as a few of the old school can testify.

* * *

Como, in his page, "The Krank's Korner"—a breezy section devoted to most everything — employed an early form of razz on the foundryman who buys pig iron by brand alone. He said,

"Reflecting somewhat on the uncertainty of things *** knowing ones often detect a difference in the same wine placed in bottles with different labels, and the ordinary individual cannot tell the difference between a FIVE AND A TEN CENT cigar **** yet actually find a certain kind of pig iron unsuitable and unknowingly are induced to try the same iron under another name and find it to be just what was wanted."

Happy Days! Such attractive subjects for comparison then were available.

* * *

THE FOUNDRY then was published monthly in Detroit.

* * *

Doesn't this sound familiar?

"Never at any previous time since the late war, at all events, have so many causes combined at one time to undermine the country's prosperity."

Wonder what the editor meant by the "late war"!

* * *

James Larkin wrote instructively on the improved copper alloy known as aluminum bronze.

* * *

W. Edward, writing Chapter VIII of "the Unvarnished History of a Common Man," was robbed of $400 in Huntington, Va., and as only $2 a day was being paid in that city, he bummed his way to Birmingham, then to Memphis and finally Chattanooga, finding the South full of molders out of work. The only doubtful part of the story is the $400.

FAKED FOUNDRY FACTS

A JIG

The Foundrymen's association of Chattanooga held its monthly meeting and announced an eminent chemist for the attraction at the next following session.

* * *

The total production cost of a ton of pig iron in the Birmingham district was approximately $8.82.

* * *

Johnston & Jennings Co., Cleveland, was incorporated June 25 to do a general foundry business.

* * *

The regular monthly meeting of the Philadelphia Foundrymen's association was held July 5 in the Manufacturers' club, where it still meets regularly. Thomas Devlin, for many years president, was in the chair. His son, Frederick Devlin, now heads the Philadelphia organization.

* * *

The large pipe foundry of R. D. Wood & Co., Florence, N. J., was destroyed by fire on July 8.

* * *

Johnny, the apprentice boy, explained how he obtained first iron for his brake shoe molds. "I put skim gates on 'em, so the old man thinks they is something as has to be clean." Bet he owns that shop today!

* * *

Thomas D. West, presented a paper on round vs. square test bars at a meeting of the Western Foundrymen's association held in Chicago, June 20. A committee was appointed to experiment and report at the next meeting. *Did someone say the question still is open?*

* * *

1904

MONDAY, June 6, marked the start of the meeting of the American Foundrymen's association in Indianapolis. Willis Brown, Erie, Pa., president, was succeeded by C. J. Wolff, Wolff Mfg. Co., Chicago. Dr. Richard Moldenke, who was re-elected secretary, just completed his castle at Watchung, N. J. The Associated Foundry Foremen held their second annual meeting. James A. Murphy, now residing in Hamilton, O., was secretary. Carbon, pig iron, cast iron and castings, specifications, subjects today strangely familiar then engaged attention in papers and dis-

(*Concluded on Page* 533)

THE FOUNDRY

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Powdered Coal Fuel Has Future

UTILIZATION of powdered coal in the malleable iron industry, both for melting the iron and afterward annealing the castings is not new, but on the other hand it has not yet been adopted universally.

As a result many foundrymen are unfamiliar with its application, are inclined to be skeptical of the claims set forth by the manufacturers of powdered coal equipment and by the managers of plants in which the equipment has been installed. This conservative attitude is characteristic of the foundry industry, particularly where radical changes in practice are proposed.

Theoretically, coal may be burned more efficiently in the powdered than in any other form, but mechanical and other difficulties incident to its utilization in the earlier forms of conveying and burning equipment prejudiced some against its use and prevented them from following the constant improvement in equipment and methods that have marked the efforts of manufacturers in this line over a recent period of approximately 10 years. Again, where satisfactory results have been secured and where a large tonnage of high grade castings are produced from furnaces and ovens fired with oil or with hand-fed coal, a manager naturally is loath to change his practice and adopt something with which he will require some time to arrive on a familiar footing.

Powdered coal does not offer a panacea for all the ills to which a malleable foundry is subject, but the many advantages theoretical, apparent and otherwise presented by its use in the plants where it has been adopted and given a fair and impartial trial would seem to indicate that at least the subject is worthy of careful consideration. Like any other innovation, the process upon its introduction does not always receive whole hearted cooperation from the entire organization and as a result its latent possibilities are not thoroughly demonstrated. This probably is the most severe handicap to the universal introduction of the method. Open hostility or actual neglect may be combated, but the management endeavoring to introduce new methods in an atmosphere of indifference or concealed antipathy has a difficult uphill burden to carry. Foundrymen who are yet a long way from the allotted three score and ten years may recall quite readily the opposition offered to the introduction of the early molding machines. In many cases machines were installed and operated, but so many accidents happened to them and the production was so unsatisfactory that it was no uncommon sight to see the machines after a short time dumped in a corner and allowed to rust into scrap. Today the foundry without a molding machine is the exception and in a great many foundries the entire output is made on molding machines.

Equipment connected with the melting and annealing of malleable castings represent a greater capital investment than that involved in the installation of molding machines and, therefore, the transition period between the use of one form of fuel and another may extend to some considerable length, but when the many advantages of powdered coal are appreciated fully it probably will be adopted universally for many purposes.

Trade Outlook in the Foundry Industry

DRASTIC curtailment has affected foundry operation in many lines, while orders and inquiries for castings are at a low point. The larger production shops are the most severely affected, some running on a schedule of less than 30 per cent of capacity, and others being closed for periods varying from a few days each week to the entire month of June. The latter, probably are the most fortunate, particularly where the large shops are considered, by reason of the ruinous overhead encountered under reduced operation. The automobile foundries probably represent the low point of the curve of foundry activity, while the pipe and sanitary ware foundries still are running full time.

Autos Hard Hit

With exception of a few of the highest priced and again the most modestly priced automobiles, sales have dropped away almost to the zero point with the approach of the summer season. One maker of passenger cars ranging in the highest priced class, but with a small production, has orders on hand sufficient for several months, but this case constitutes only an exception. Preliminary estimates place the May output of all classes of automobiles at 301,000, the smallest since February, 1923. This is 19 per cent below the April total and 23 per cent under the peak of May, 1923, which set a record. Production for the first five months of the year totaled 1,742,832 cars which was almost 100,000 ahead of the same period last year. Further, the first five months of this year exceeded any full year, previous to 1917. However, few look for the full swing of production for the remainder of the year and many believe that this year will fall behind 1923 in the total output by several hundred thousand. Cylinder foundries practically are at a standstill, as the few factories working are merely using up stock.

Prices for Raw Material for Foundry Use

CORRECTED TO JUNE 20

Iron		Scrap	
No. 2 Foundry, Valley	$19.50	Heavy melting steel, Valley	$15.75 to 16.00
No. 2 Southern, Birmingham	19.00 to 20.00	Heavy melting steel, Pitts.	16.50
No. 2 Foundry, Chicago	20.50 to 21.00	Heavy melting steel, Chicago	13.50 to 14.00
No. 2 Foundry, Philadelphia	21.26 to 22.26	Stove plate, Chicago	15.00 to 15.50
No. 2 Foundry, Buffalo	19.00 to 20.00	No. 1 cast, Chicago	17.50 to 18.00
Basic, Valley	20.00	No. 1 cast, Philadelphia	17.50 to 18.50
Basic, Buffalo	19.00 to 20.00	No. 1 cast, Birmingham	17.00 to 18.00
Malleable, Chicago	20.50 to 21.00	No. 1 cast, Buffalo	17.50 to 18.50
Malleable, Buffalo	19.00 to 20.00	Car wheels, iron, Pittsburgh	17.50 to 18.00
Coke		Car wheels, iron, Chicago	15.00 to 15.50
Connellsville foundry, coke	$4.50 to 5.50	Railroad malleable, Chicago	16.00 to 16.50
Wise county foundry, coke	4.00 to 5.00	Agricultural mal., Chicago	15.50 to 16.00
		Malleable, Buffalo	19.00 to 19.50

Cast Pipe Holds Up

Southern and eastern cast-iron pipe foundries are busy, and the outlook indicates that full time operation can be sustained until fall. This division of the foundry industry, with the sanitary-ware makers and the radiator shops constitute the favored ones among the castings plants. Orders for enameled sanitary ware are dropping. The total of bath tub orders placed in May was only 74,494, while shipments were 101,146, according to the department of commerce. However, unfilled orders continue high being listed at 214,309 for May and 239,118 for April. The shrinkage in unfilled orders started with April, for the previous month showed 245,921 bath tubs on the books. The total of bath tubs listed as unfilled orders during the first five months was 1,150,922 and the shipments for the same period are given as 514,977. From this it is evident that enough of a backlog is at hand to sustain full time operation for a considerable period. Radiator works also are active, but stove foundries have encountered a lull unprecedented in the experience of many manufacturers. The decline has been more rapid and to a lower level than during 1924, but recovery is expected to follow in the late summer or early fall. In many quarters this slacking down is regarded generally as the usual condition prevailing in any presidential election year.

Iron Sales Heavy

Pig iron buying picked up remarkably during June. Apparently many of the larger users, who usually come on the market as iron approaches a low price level, felt that the time was appropriate. In a period of three weeks, sales of over 400,000 tons of pig iron were reported. Of this amount some 75,000 to 80,000 tons was stated to have been purchased by the American Radiator Co., while pipe makers, malleable and other large interests made up the difference to the total noted. This buying movement is taken by many to indicate a return to the former practice of forward buying. Smaller buyers, up to the present have not manifested an interest, although new low levels in prices are reported in foundry grades. Steel castings production which reached unprecedented high levels during the past year is dropping. According to the department of commerce, the total production for May was at the rate of 55.4 per cent of capacity, compared with 65.2 per cent for April and 99.8 per cent for March. Railway steel castings shops were slightly in the lead, showing 71.7 per cent of capacity production for May, compared with 84.7 per cent for the previous month. The same relative condition obtained in malleable foundry operation. Those shops which are making railway work, both for new cars and for repairs are more active than those making miscellaneous lines, while the automobile malleable shops are practically at a standstill. Railway buying, active in the forepart of the year has decreased. With the exception of scattering orders for a few hundred cars, buying is lacking. In May the number of freight cars ordered totaled only 511, compared with 10,253 for April and 9800 for March. An inquiry for 40 locomotives from the New York Central in June was considered exceptional.

Nonferrous Operations

Plumbing goods foundries are operating on a reduced schedule. New York prices for nonferrous metals, according to the *Daily Metal Trade* of June 21, follow: Casting copper, 12.25c; electrolytic copper, 12.40c to 12.45c; Straits tin, 43.00c; lead, 7.00c; antimony, 8.37½c; nickel, 30.00c; aluminum, No. 12 alloy, remelt, 21.00 to 22.00c. Zinc is 5.72½c to 5.75c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

R. O. PATTERSON recently elected president of the Institute of British Foundrymen and installed in office at the Newcastle-upon-Tyne convention June 4-6 was born in 1876 at Blaydon-on-Tyne and with the exception of several years spent in travel in foreign countries, all his active foundry life has been spent on the northeast coast. For many years he has been managing director of Smith-Patterson & Co., Ltd., who conduct a large

R. O. PATTERSON

foundry in Newcastle-upon-Tyne, one part of which is devoted to the manufacture of marine engine and general jobbing castings and the other part is fitted in a special manner for mass production of railroad chairs. An interesting description of this foundry was published in the June 15 1923 issue of THE FOUNDRY.

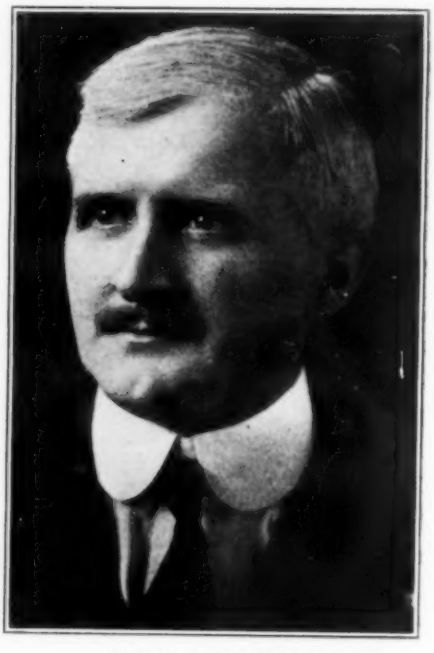
After an education obtained at Newcastle and on the continent of Europe Mr. Patterson served an apprenticeship with R. & W. Hawthorn, Leslie, Co., Ltd., Newcastle-upon-Tyne and then spent two years in the United States where he worked in various foundries including the Risdon Iron Works and the Fulton Iron Works, San Francisco. He then visited Honolulu, Apia, New Zealand and Australia. Leaving Australia at the expiration of a few months he sailed for South Africa and remained there for two years. He had some foundry experience in this country and also served through part of the Boer War as a member of the South Africa Light Horse. At the close of the war he returned to England and became identified with Smith, Patterson & Co., Ltd., Newcastle-upon-Tyne, where as previously stated he holds the position of works manager and director. In 1919 Mr. Patterson paid an extended visit to the United States commencing with an attendance at the American Foundrymen's convention in Philadelphia and afterward embracing a tour of all the important foundry centers as far west as Chicago.

Mr. Patterson joined the Institute of British Foundrymen soon after its inception and was elected president of the Newcastle branch in 1920. He is a member of the American Foundrymen's association and a member of the council of the British Cast Iron Research association.

G. H. Kinney, electric appliance engineer, General Electric Co., Schenectady, N. Y. spoke before the Philadelphia Foundrymen's association, June 11, on "Electricity in the Foundry, Referring Particularly to the brass and Bronze Foundry." W. H. Radamacher, illuminating engineer, Edison Lamp Works, General Electric Co., Harrison, N. J. spoke on "The Relation of Proper Illumination to Production in the Foundry."

J. C. Merwin, works manager of the Chain Belt Co., Milwaukee, was elected second vice president of that company at a meeting held recently. Mr. Merwin is a graduate of Sheffield Scientific school, Yale university and has been associated with the Chain Belt company since 1917. Other officers elected are as follows: President C. R. Messinger, first vice president Clifford F. Messinger, treasurer C. L. Pfeifer, secretary Brinton Welser, and assistant secretary C. E. Stone.

Robert Crawford, the Atlas Foundry Co., recently elected president of the Detroit Foundrymen's association, served seven years apprenticeship to the molding trade between Hyde Park and Plantation Foundries in Glasgow, Scotland. Since emigrating to the United States in July, 1902, his experiences have been varied, working with the Allis-Chalmers Mfg. Co., West Allis, Wis., and with the Filer & Stowell Co., Milwaukee. From 1905 until 1908 he was employed in the New York, New Jersey and Pennsylvania section, working as a molder where he gained considerable experience as to American methods. In 1908 he went to Detroit and was employed as foundry foreman in the Detroit Foundry Co. and later in the Murphy Iron Works. In 1910 when the Atlas Foundry was organized he was employed as foundry foreman and in 1911 was made foundry superintendent. The Atlas Foundry got into difficulties through the failure of the United States Motor Co. and for the loyalty he showed during this financial crisis and his application to industry, he was appointed secretary and manager in 1913. In August, 1914, he was elected president and general manager and has remained in this position since. Through his hard work and diligent effort the Atlas Foundry Co. has built up an excellent reputation as manufacturers of high grade motor castings.



ROBERT CRAWFORD

When the sale of the Lincoln Motor Co. was completed, the government put in a claim against the Lincoln Motors for $9,180,000. Unknown to anyone, Mr. Crawford went to Washington and took the matter up with the department of justice and secured a settlement, for which he received the grateful thanks and appreciation of all the Lincoln creditors. Largely through his efforts the Lincoln creditors received one hundred cents on the dollar.

Mr. Crawford is much interested in the technical training of young men for the foundry industry and takes keen in-

terest in the University of Michigan, from which his oldest son, who now is associated with him in the Atlas Foundry Co. was graduated last June. Mr. Crawford always has been active in the Detroit Foundrymen's association and served as vice president and director for several years. The election to the presidency of this important association is a further step in the recognition of Robert Crawford as one of the leaders in the foundry world.

Bradley Stoughton, professor of metallurgy, Lehigh university, Bethlehem, Pa., will sail July 19 for Europe and expects to return Sept. 20.

E. Ramas, director of the Societe Francaise Metallurgique which represents the Griffin process in France, has been re-elected president of the Association Technique de Fonderie of France. Mr. Ramas has occupied this post since October 1920. He attended the convention of the American Foundrymen's association at Cleveland last year on behalf of the French association.

A. Damour, managing director of the Societe des Fonderies de Bayard et Saint-Dizier and of the Societe des Hauts-Fourneaux de Maxeville, has also been re-elected first vice president of the Association Technique de Fonderie. J. Leonard, past president of the Association Technique de Fonderie de Belgique, has resigned his post in the French association as vice president for Belgium. G. Masson, present president of the Belgian association, has been elected in his place.

Malleable Plant Placed In Service

(*Concluded from Page* 526)

equipment also is elevated. All exhaust pipes, motors and line shaft are out of the way in the space between the platform and the main floor. Dust arresters are placed on the roof. Directly beyond the soft iron mill room is the shipping department, which is located in a three story building having a motor truck bay and a direct siding connection with the Chicago & North Western railroad. This department is equipped with four drop hammers, 11 grinders and two portable grinders, equipment necessary in turning out good castings for the automotive trade.

The material yard is 90 x 900 feet, lying between the foundry and annealing buildings. A 10-ton overhead crane equipped with magnet and bucket will serve it. For storing core sand there, a concrete building with two bins of 675 and 975 tons capacity each will be used. Molding sand will be stored in three bins of 975 tons each and one of 675 tons. Six thousand tons of pig iron can be piled, along with 1000 tons of steel scrap, 1200 tons of malleable scrap and 400 tons of furnace coal in the hopper and space is available for 3000 tons more in the yard.

Across the street from the foundry building, but connected with it by a tunnel will be the power house, 52 x 85 feet. Its equipment will include one 300 kilowatt generator, two steam driven and three electric driven air compressors with a combined capacity of 3900 cubic feet per minute. The main distributing switchboard and the hot water system heaters will be placed here. A forced hot water circulating system will heat the entire plant. The present service building, which is 65 x 140 feet, is being remodeled into a modern carpenter and machine shop and pattern shop and storage. The present fireproof pattern storage room is being enlarged.

The chemical laboratory doubtless is one of the best equipped in connection with a malleable foundry in the central west. Its equipment includes testing machine for ascertaining tensile strength and elongation. A trained nurse is on duty at all times in a thoroughly-equipped first-aid room and in addition does home visitation work. In the men's washroom are four showers and three circular fountains, each one of which accommodate 10 men at a time. A one-story office building and a one-story garage are across the street from the foundry proper.

In an adjacent foundry, operated as the Racine Steel Castings Co., the Belle City Malleable Iron Co. has a 3-ton Heroult electric furnace, which has been in operation since 1916. In this department electric steel castings are produced for tractors, automobiles, railroad specialties and miscellaneous equipment. C. S. Anderson is general manager and M. J. Goepfert general superintendent of the Belle City plant. P. M. Adams is the resident architect employed by the company.

Milestones In Foundry Progress

(*Concluded from Page* 529)

cussions. The Atlas Engine Co. plant was inspected. This now is the Midwest Engine Co.

* * *

The World's Fair in St. Louis proved a counter attraction and drew 60 American Foundrymen's association visitors from the inspiring presence of the Indianapolis soldiers' and sailors' monument to the memorable Pike. Of course, the American Foundrymen's association exhibit at the fair probably was the real magnet drawing the pilgrims westward.

* * *

No. 2 Foundry, Birmingham was quoted at $9 while northern iron of similar grade brought $12.

* * *

A. E. Outerbridge Jr., William Sellers & Co., Philadelphia, sustained the argument put forth by housekeepers that a flat iron, used for some time for its lawful purposes, of course, would not retain heat. Repeated heating resulted in porosity, he said.

* * *

Fred Stockwell, then as now, guided the New England Foundrymen's association as secretary. The apprentice question was discussed by O. P. Briggs, Minneapolis at the meeting on June 8.

1914

JULY, 1914, the twilight period before the world war, marked the passing of the foundry where Seth Boyden experimented continuously for six years before he produced the first malleable iron. This was noted in a description of the Barlow Foundry Co., Newark, N. J., plant, which superseded Boyden's foundry established in 1826. Richard H. Gatling, son of Dr. Gatling the inventor of the gun which bears his name, was secretary of the then new Barlow foundry.

* * *

Sivyer Steel Casting Co., Milwaukee established a record of 23 blows in eight hours in a one-ton converter.

* * *

Standard Brass Foundry, Columbus road, Cleveland, was noted as making a 12-cylinder, marine, gasoline-engine crankcase for a racing power boat.

* * *

Robert Buchanan advised members of the British Foundrymen's association to anneal gray iron castings for textile machine spindles.

* * *

Edgar Allen Custer and T. Ben Bennett discussed cupola bridging following previous remarks by W. J. Keep in an earlier issue.

* * *

John E. Sterling, president of the American Electroplaters' society at its meeting in Milwaukee June 30, 1924, 10 years ago was treasurer of that society when the meeting was held in Chicago.

* * *

Safety considerations apparently were receiving much attention. The committee of the National Founders' association devoted considerable time to points on handling ladles. Safety clothing was recommended, preheating was insisted upon and molders were advised never to catch under from back of the screen. In another portion stress was directed on the importance of protecting helmets and goggles in sand blasting, welding, etc.

Equipment Outlook Brighter

Greatly Increased Volume of Inquiries Causes Better Sentiment Among Manufacturers—Sales of Equipment Reported Heavier by Some Makers —Many Plants Making Extensive Repairs

SENTIMENT in the market for foundry equipment has shown considerable improvement during the past month. In many cases makers report that sales for June were in excess of the volume realized during May and that there has been a slight betterment in conditions each month for the past several months. Inquiries have increased substantially during the past two weeks, and although some users are slow in closing on needed equipment, some manufacturers feel that a real buying movement will be in progress soon. Considerable repair work is being done and many shops now working on light schedules contemplate extensive repairs on equipment. The Pangborn Corp., Hagerstown, Md., has sold sand blast and dust arrester equipment to the W. K. Henderson Iron Works & Supply Co., Shreveport, La. The W. W. Sly Mfg. Co., Cleveland, has placed tumbling mill equipment with the McQuay-Norris Mfg. Co., Connersville, Ind., and the Nickle Plate Foundry Co., Cleveland. Gohmann Bros. & Kahler Co., New Albany, Ind., has purchased a pouring device from the Modern Pouring Device Co., Port Washington, Wis. In the June 15 issue the items listed as sold by the Pangborn Corp. in the Cleveland territory should have been credited by the W. W. Sly Mfg. Co. and those sold by the W. W. Sly Mfg. Co. to the Pangborn Corp.

Slight Gains Registered in East

WHILE foundry equipment buying as a whole in the eastern district is far from brisk, nevertheless, the slight improvement noted recently is being maintained. Few new projects or additions are being considered. However, the restricted operations at the majority of foundries is giving operators an opportunity to make repairs and alterations and apparently this is the chief contributing factor to the improvement prevailing at this time.

In some lines the market is described as being active. One large manufacturer of sand blast equipment asserts that there has been a marked spurt within the past fortnight, and as a result his company is sold up a month or six weeks in advance, whereas recently he could make prompt delivery. This improvement also extends to sand cutters.

A leading order of late calls for considerable foundry equipment for a new plant to be erected in Mexico by the Ferro Carrill Mexicano railroad. This business went to the Whiting Corp., Harvey, Ill., and includes a cupola, blowers, ladles, linings, etc. A Brooklyn, N. Y., foundry recently closed on two 1-ton, short span, transfer crane, to the Chisholm-Moore Mfg. Co., Cleveland. The Boynton Furnace Co., Jersey City, N. J., is understood to be contemplating the purchase of molding equipment for its new foundry shortly. The bulk of the equipment for this plant, however, has been purchased.

The Pangborn Corp., Hagerstown, Md., has sold sand blast and dust arrester equipment to the American Abrasive Metals Co., Irvington, N. J. The Continental Heater Corp., Dunkirk, N. Y., has purchased a tumbling sand blast mill of the continuous tumbling action type from the W. W. Sly Mfg. Co., Cleveland. The International Motor Co., Brunswick, N. J., is considering the installation of an electric brass furnace.

Included in the few new projects under contemplation, is a sash weight foundry to be erected by a scrap dealer in the New York Metropolitan district. Plans are expected to be announced soon. Prices on equipment generally are unchanged, although marked weakness is noted in cranes.

Buying Remains Slack

WHILE demand for foundry supplies continues to increase, buying of equipment is still at a decidedly low point throughout New England. The Draper Corp., maker of textile castings, Hopedale, Mass., is in the market for an air compressor and other similar equipment in connection with foundry alterations. The Hunt Spiller Mfg. Corp., Boston, purchased a sand mixer from the National Engineering Co., Chicago, and is understood to be in the market for some additional equipment. This company manufactured railroad castings. The Plainville Castings Co., Plainville, Conn., bought a sand separator from the Royer Foundry & Machine Co., Wilkesbarre, Pa., and the General Electric Co. at Lynn, Mass., has purchased some foundry equipment and is in the market for some additional items. Brown Bros., Stamford, Conn., is inquiring for a sand separator and some other equipment. A Massachusetts foundry is inquiring for a 10-ton crane. Some scattered inquiry for molding machines and industrial tractors is reported but nothing pointing to any immediate buying movement. Foundrymen in this district are adopting a waiting policy in all of their buying and it is only production equipment which finds an occasional sale.

Expect Buying Movement in Fall

IMPROVEMENT in foundry equipment buying among the foundries of the Pittsburgh area is spotty. The trade generally believes that no real betterment may be expected before fall. Occasionally a new foundry has to have equipment, a case in point being the Kensington-Davis Corp., Buffalo, which among other items purchased six large machines for its new foundry from the Herman-Pneumatic Machine Co., Zelienople, Pa. This latter manufacturer also sold two large rollover machines to the Ohio Steel Foundry Co., Springfield, O., and two to the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., as well as one each to the Standard Sanitary Mfg. Co., New Brighton, Pa., and the Raritan Foundry Co., Raritan, N. J. The J. S. McCormick Co., Pittsburgh, has sold among other items, core ovens to the Allegheny Steel Co., Brackenridge, Pa., and the Pittsburgh Gray Iron

Foundry, Inc., Pittsburgh, as well as a sand mixer to the Canton Malleable Iron Co., Canton, O. It also disposed of a used 5-ton hand power crane built by the Whiting Corp., Harvey, Ill., to the Specialty Foundry Co., Ellwood City, Pa.

Other crane purchasers include the General Electric Co., Pittsfield, Mass., two 100-ton overhead traveling cranes from the Miles-Bement-Pond Co., New York; the Gould Mfg. Co., Seneca Falls, N. Y., one 3-ton 3-motor single I-beam crane from the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; the Westinghouse Electric & Mfg. Co., Attica, N. Y., one 5-ton 56-foot, 2-inch span 3-motor crane from the Milwaukee Electric Crane & Mfg. Co., Milwaukee; the Aluminum Co. of America, New Kensington, Pa., one 5-ton overhead crane from the Northern Engineering Works, Detroit; the Westinghouse Electric & Mfg. Co., Sharon, Pa., two 5-ton cranes from the Whiting Corp.; the Westinghouse Electric & Mfg. Co., Sharon, Pa., three 3-ton cranes from the Northern Engineering Works, Detroit. The largest crane inquiry before the trade here is that of the Westinghouse Air-brake Co., Wilmerding, Pa., calling for five 5-ton cranes, one 3-ton crane, and five 3-ton 2-motor cab-controlled hoists. A few other foundries in this immediate vicinity and in nearby districts are in the market for single crane installations, including the Marion Foundry Co., Marion, O., one crane of 10-ton or 15-ton capacity.

The Chapman-Stein Furnace Co., Mt. Vernon, O., recently completed a car-type recuperative normalizing and annealing furnace for the Buckeye Steel Castings Co., Columbus, O. This furnace will have a 10-ton per charge capacity for annealing steel castings. F. J. Ryan & Co., Philadelphia, recently sold electric heat treating furnaces to the Pratt & Whitney Co., Hartford, Conn.; burner equipment for a rotary brass furnace, Reading, Pa., and two large car annealers and two 4-door billet-heat furnaces and control equipment to the Westinghouse Electric & Mfg. Co., Philadelphia. Most of the equipment required by the Parker White Metal & Machine Co., Erie, Pa., in its larger quarters has been purchased. Some small items remain to be bought. The Erie Malleable Iron Co., Erie, Pa., is a prospective purchaser of equipment for its new addition, as is the Christiana Machine Co., Christiana, Pa., which is putting up a gray iron foundry addition. The Pangborn Corp., Hagerstown, Md., has sold sand blast and dust arrester equipment to the Bethlehem Steel Corp., Bethlehem, Pa. Brass foundry equipment probably will be closed by the General Foundry & Machine Co., McDonald, Pa., and the Hall Steam Pump Co., Pittsburgh, moving into larger quarters, may need additional supplies and equipment. Occasional orders for flasks, riddles, etc., come in, one lately calling for 50 flasks to a local user being received by a prominent seller here. Sales of wheelbarrows, shovels, etc., at the present time are limited.

Fail to See Much Increase

ALTHOUGH pig iron producers claim to be making fairly heavy sales of iron to the larger foundries, makers of foundry equipment cannot see any increase in foundry operations and until this comes they fear sales of equipment will not be greater. Recent sales of sandslinging machine by the Beardsley & Piper Co., Chicago, include two of the stationary type to the Wolff Mfg. Co., Chicago; one of the tractor and one of the stationary type to the Studebaker Corp., South Bend, Ind.; one of the tractor type to the National Cast Iron Pipe Co., Birmingham, Ala., and one each of the stationary type to the Whitehead & Kales Iron Works, Detroit, and the Crane Enamelware Co., Chattanooga, Tenn. The National Engineering Co., Chicago, has sold sand mixers to the Albany Car Wheel Co., Albany, N. Y.; Irvington Smelting & Refining Co., Irvington, N. J., and the Pawling & Harnischfeger Co., Milwaukee.

The W. W. Sly Mfg. Co., Cleveland, has sold sand blast rooms and dust arrester equipment to the Commonwealth Steel Co., Granite City, Ill.; a tilted sand mill of the positive pressure type to the Saginaw Malleable Iron Co., Saginaw, Mich.; tumbling mills to the Jewell Steel & Malleable Co., San Francisco and the Enterprise Foundry Co., Detroit; dust arrester equipment to the Ford Motor Co., Detroit, the Packard Motor Car Co., Detroit and the International Harvester Co., Chicago. Sand blast and dust arrester equipment has been sold to the Michigan Motor Castings Co. of the Buick Motor Co., Flint, Mich., by the Pangborn Corp., Hagerstown, Md. The same manufacturer has sold sand blast equipment to the Rock Island Stove Co., Rock Island, Ill.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Davis Foundry & Machine Works, Rome, Ga., is in the market for a light steel frame warehouse storage building.

Woolstock Co., Atlanta, Ga., has taken out permits for constructing an addition to its foundry.

J. P. Ward Foundry, Elmira, N. Y., plans moving its plant and equipment to Blossburg, Pa.

The Hayes Brass Foundry, Inc., Syracuse, N. Y., has filed a petition in bankruptcy with liabilities listed at $11,978 and assets of $8256.

The United States Cast Iron Pipe & Foundry Co., Birmingham, Ala., recently was damaged slightly by fire.

Endicott Forging & Mfg. Co., Endicott, N. Y., is installing a new pickling machine and is building a brick addition to its plant. S. J. Marshall is president and treasurer.

Milwaukee Die & Tool Co., 136 Reed street, Milwaukee, has changed its name to Advance Tool & Die Casting Co., following the recent establishment of a die casting department.

R. D. Wood & Co., Philadelphia, recently enlarged its machine shops, hydraulic valve plant, brass foundry, pattern shop, gray iron foundry and other departments.

Joseph Fabian and P. F. Devany have opened a brass and aluminum foundry at 1907 Indiana avenue, Chicago, under the name of Hunter & Co.

Perry Foundry & Machine Co., Perry, Fla., has under way the building of an addition to its foundry. H. T. Wilkes is head of the company.

The Pacific Malleable Castings Co., Emeryville, Cal., is constructing a foundry near Elmhurst station, the plant to contain about 55,000 square feet of floor space.

The Rockwood Stove Works, Rockwood, Tenn., operator of a gray iron foundry and manufacturer of stoves, has increased its capital stock from $50,000 to $100,000.

The Greenville Steel & Foundry Co., Greenville, S. C., is in the market for riveting hammers, chippers, reamers, bolt machines, hoists, etc. E. R. Saunders is chief engineer. *Noted June 15.*

The American Boiler & Foundry Co., Milan, Mich., plans constructing an 80 x 200-foot addition to its plants for production of gray iron castings. E. L. Watson is president. Noted *June 15.*

The foundry and machine shop of the Franklin Valveless Engine Co., Franklin, Pa., recently badly damaged by fire, will be rebuilt. Work already has been started on re-

construction.

American Foundry Co., Hot Springs, Ark. has been chartered with $10,000 capital stock, to engage in a general foundry business, with W. F., C. H. and T. M. Fullington, that city, as incorporators.

United States Radiator Co., Broadway and Grand river, Detroit, manufacturer of radiators and heating equipment, has let contracts to the Concrete Steel Co. for constructing a plant addition.

The Launchy Foundry & Machine Co., Jackson, Miss., has increased its capital stock from $50,000 to $75,000 and additional facilities will be provided for in its current expansion program.

Ohio Pattern Works & Foundry Co., 2730 Spring Grove avenue, Cincinnati, has purchased a site at Spring Grove and Marshall avenues, where it plans constructing a plant. J. F. Hansfield is vice president.

The Reliable Pattern Works Co., Cincinnati, has been incorporated for $15,000 to manufacture patterns, etc., by Elmer Young, Edward Korten, George E. Kearns, Arthur Kuhn and John Young, Jr.

Parker White Metal & Machine Co., Erie, Pa., maker of die castings, has purchased most of the equipment which it will need for an expansion program now under way. W. A. Parker is connected with the company.

American Sanitary Mfg. Co., Abingdon, Ill., has awarded contracts for a $75,000 plant, to Bohrer, Denlevy Co., Lockwood, Greene & Co., Boston, 38 South Dearborn street, Chicago, are engineers.

Buffalo Sash Weight & Foundry Co., Buffalo, N. Y., has been incorporated with $100,000 capital, to manufacture sash weights and conduct a general foundry business, with J. and M. M. and F. Rosen as incorporators and I. Setel, Buffalo, as attorney.

Bettendorf Co., Davenport, Ia., operator of a steel foundry, plans constructing electric power house and installing equipment, the complete expansion program to involve an expenditure of about $200,000. J. J. Bettendorf is president.

Pullman Mfg. Co., Rochester, N. Y., has been chartered with $100,000 capital to manufacture window balances, and do a general metal casting business, with J. L. Willard and H. G. Williams as incorporators and R. B. Ingalsbee as attorney.

National Castings, Ltd., Belleville, Ont., is building an addition to its plant, and contemplates installing new equipment, including a modern cleaning plant. The company is interested in the purchase of sand blast equipment, etc.

Nickel Plate Foundry Co., Coit road, Cleveland, has started construction of an 80 x 150-foot foundry for light gray iron castings. The A. A. Lane Construction Co. is general contractor. H. M. Morse & Co., Finance building, Cleveland, is architect. *Noted March* 15.

French & Hecht, Davenport, Ia., machinists and founders, have let contract to Rock Island Bridge & Iron Works, Rock Island, Ill., for a 1-story plant addition. Frank D. Chase, Inc., 712 North Michigan boulevard, Chicago, is architect. *Noted June* 1.

Accurate Pattern & Foundry Co., 810 West Lake street, Chicago, has been incorporated with $10,000 capital, to manufacture and deal in wood and metal patterns, dies and models, by Ralph J. Feldman, George A. Larson and Axel E. Hult.

Watervliet Iron & Brass Foundry, Town of Colonie, Albany, N. Y., has been incorporated with $10,000 capital, to conduct a general foundry business, by R. A. Tees, A. W. Meyer and J. C. Rohleder, with E. McLean, Watervliet, as attorney.

The Berkeley Steel Construction Co., Berkeley, Cal., has started constructing a building at Second and Camilla streets, that city, for use as a machine shop and a foundry for gray iron castings. T. S. Neilson is president and general manager of the company.

The Standard Sanitary Mfg. Co., Bessemer building, Pittsburgh, has rejected bids on a 4-story, 80 x 149-foot warehouse and plant at Indianapolis. Bids will be taken later in the year by Hunting & Davis, Century building, Pittsburgh. The Standard company operates gray iron, brass and aluminum foundries.

The Dominion Forge & Stamping Co., Ford, Ont., has let general contract to Wells & Gray, Ltd., Toronto, Ont., for a plant.

The Canadian Steel Foundries, Ltd., Longue Point, Que., has awarded the general contract for a foundry addition, to John MacGregor, Ltd.

Standard Sanitary Mfg. Co., Bessemer building, Pittsburgh, has let contracts to L. W. Hancock, Louisville Trust building, Louisville, Ky., for a 1-story, 140 x 180-foot foundry in the latter city. Joseph & Joseph, 800 Francis building, Louisville, are engineers and architects. *Noted May* 15.

The Columbia Bronze Co., Youngstown, O., recently incorporated, has purchased a foundry site with a partially burned building thereon. Work will start shortly on completing and repairing the building for the production of bronze and alloy castings. Operations are expected to begin by fall.

A. J. Lindemann & Hoverson Co., Milwaukee, manufacturer of stoves, has awarded contracts to the Great Lakes Construction Co., 308 South Wabash avenue, Chicago, for a 6-story plant in the latter city. The company operates gray iron, brass, malleable and aluminum foundries. *Noted April* 15.

The Marine Engine Works & Shipbuilding Co., Tarpon Springs, Fla., has been incorporated with $25,000 capital to build engines for marine work and to operate a foundry for casting engine parts. R. Kaminis is president of the company, Minas F. Saris, vice president, C. G. Tulmaris, secretary and A. Kaminis, treasurer and general manager.

Ashland Clay & Metal Products Co., Ashland, Ky., is planning construction of a machine shop, repair shop and foundry at Bellfonte crossing. Units will be of brick and steel, 65 x 135 feet and 45 x 300 feet. A monthly capacity of 500 tons of gray iron castings is planned. Dick Peebles and Leo Meehan are in charge.

Hanford Foundry, Hanford, Cal., recently purchased by P. J. Fasullo, formerly connected with the Best Steel Casting Co., Oakland, Cal., is installing a compressor, a jarring machine, a combined jar roll over machine, and a furnace for melting brass. The company will manufacture piston rings and do general jobbing in gray iron, brass and aluminum foundry work.

All necessary equipment for plant expansion of the East St. Louis Castings Co., East St. Louis, Ill., already has been purchased, according to Ralph W. Hill, president of the company. A 2-story 28 x 80-foot building is being constructed to house the core room and sand blasting departments on the lower floor and pattern shop and pattern storage on the second floor. A 75 x 125-foot, 1-story, monitor type building is being constructed as an addition to the foundry proper. *Noted May* 15.

The Fairfax Iron & Steel Co., Kansas City, Kans., manufacturer of steel, malleable and gray iron castings, is constructing a foundry to have a capacity of 24 tons a day. A cupola with 20 tons a day capacity and a frog and switch works shop are being installed. All buildings and materials have been purchased excepting a 3-ton electric melting furnace, eight heavy duty frog and switch planers and one drop hammer. Walter W. Shaw is president of the company.

New Trade Publications

HOISTS—The Hanna Engineering Works, Chicago, has published a folder describing air hoists and trolleys. The various types of hoists are illustrated and views are shown of installations.

RIDDLES—The Newman Mfg. Co., Cincinnati, has issued a 4-page folder describing and illustrating a gyratory foundry riddle. Information also is presented concerning a swing lathe for grinding and polishing heavy pieces.

BENCH GRINDER—The Hisey-Wolf Machine Co., Cincinnati, has issued a bulletin on a ball bearing bench grinder using either alternating or direct current. The various parts of the machine are described.

PUMPS—The various parts of the dry vacuum pumps manufactured by the Sullivan Machinery Co., Chicago, are described in a pamphlet recently issued by that company. The pamphlet is well illustrated with views of the parts and also of the various types of pumps.

PRESSURE BLOWERS—Blowers for oil furnaces and large coal forges are illustrated in a bulletin by the Johnston Mfg. Co., Minneapolis, Minn. Operating characteristics, general design, individual units, size of blowers and engineering data are given fully.

LUBRICATORS—"The Economy of Better Lubrication" and "The Dependable Operation of Steam Shovels, Cranes and Dredges" are the titles of two pamphlets recently published by the McCord Radiator & Mfg. Co., Detroit. Various forced feed systems are described.

CHARGING MACHINES—"How One Foundry Lowered Melting Costs" is the subject of a folder published recently by the Whiting Corp., Harvey, Ill. The economy of a cupola charging machine manufactured by that company is described.

CUPOLA FLUX—The Sulfex Corp., New York, has issued a pamphlet giving considerable information on a cupola flux which it manufactures. Directions for charging the flux are given and the methods for testing to determine the value of the compound are listed.

REPULSION START MOTORS—To avoid voltage fluctuation caused by starting small motors the Century Electric Co., St. Louis, offers repulsion starting induction single phase motors which are described in a 4-page bulletin. Graphs present data as to smoothness of starting under varying conditions.

MOTORS—The Ohio Electric & Controller Co., Cleveland, has issued two booklets on alternating current induction motors of ⅛ to 1/3 horsepower capacity. One booklet contains a description of the various parts of the motor while the other booklet pictures the many uses to which this motor may be put.

POSITIVE PRESSURE BLOWERS—In a recent bulletin, the Connersville Blower Co., Connersville, Ind., presents information on its positive pressure blowers for use in obtaining pressures of ½ to 5 pounds or vacuum of 1 to 10 inches of mercury. Details of specifications and other information are given fully in tables, and illustrations show the blowers in various types.